SOFC for Apartment Units as Next Target Growth

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1. Governmental Measures

The Ministry of Economy, Trade and Industry (METI) and the Agency for Natural Resources and Energy (ANRE) will investigate the mechanism of catalyst deterioration in fuel cells (FCs) with SPring-8. Because platinum drives the price of FCs high, the research aims to significantly reduce the amount of platinum usage. ANRE will start the research using SPring-8 from FY 2013, as a part of its "Polymer Electrolyte Fuel Cell (PEFC) Technology Development Project for Practical Application". With the earlier method, carbon was coated with metal such as gold, and platinum evenly covered the carbon to be a catalyst for the FC. By examining the method, the project has already established a better technology to distribute particles, which is platinum bonded on the surface of a metal core, optimally on carbon. This development allows a reduction in the amount of platinum to a fifth of that of the previous method. For FY 2013, the new research will test a PEFC with an even lower amount of platinum to find out the durability and performance at a high temperature and under low humidity. Furthermore, the mechanism of electrode catalyst deterioration will be studied. Platinum becomes clumped together during catalytic reactions, which reduces its effect. The research will seek a method realizing further platinum reduction, while keeping the same catalytic performance, by looking into the deterioration mechanism. (Nikkan Jidosha Shimbun, February 22, 2013)

METI will ease the regulations for the coming mass-market production of fuel cell vehicles (FCVs). By the end of April, the legitimate pressure for on-board hydrogen tank will be doubled to 70 MPa by amending the ministerial ordinance of the High Pressure Gas Safety Act. The larger pressure allows over 500 km cruising range, which is a petrol driven vehicle range, without enlarging the tank size. Currently, special permission is required for an individual vehicle to have a higher pressure tank. However, the amendment allows the manufacturers to apply for approval for a product model rather than obtaining a single approval for each individual vehicle. (The Nikkei, March 18, 2013)

2. Local Governmental Measures

(1) Kanagawa Prefecture

Kanagawa prefecture will subsidize for smart energy facilities in its installation of residential houses from FY 2013 to promote renewable energy including photovoltaic generators. Made public on February 18th, the initial budget for the FY 2013 includes ¥180.5 million of the subsidy scheme. The subject for the subsidy is a combination of home energy management system (HEMS) and one or more facilities such as Ene-Farm and a charger for an electric vehicle (EV). The prefecture expects 3,000 installations to be funded. (The Nikkan Kogyo Shimbun, February 19, 2013)

(2) Fukuoka Prefecture

On February 20th, Fukuoka prefecture announced that "Fukuoka Regional Energy Policy Research Group" had been formed to discuss stable energy supply and demand for the local government to consider and the first meeting would be held on 23rd. The group comprehensively researches promotions for power generation and balanced supply and demand suitable for the area. The research activity will be maintained for approximately two years. The group will have discussions on promotion and possible measures for local government to take to promote renewable energy, independent power sources including FC and cogeneration and more efficient coal or natural gas generation. Reports will be periodically provided with suggestions to the prefecture. (The Nishinippon Shimbun, February 21, 2013)

(3) Mitaka City

Mitaka city, Tokyo, will start a subsidy scheme for housing developers to encourage a residential development of 3,000 m^2 or larger with energy saving system such as a solar thermal utilization system. The scheme will subsidize residential development of all houses which have either photovoltaic generator or solar thermal system. The city aims to create an integrated eco town by supporting a whole development rather than individual residents. The support will go towards as follows; maximum ¥80,000 for a house with photovoltaic generator, ¥20,000 for each highly efficient water heater, ¥10,000 for each socket for an EV charger and ¥50,000 for each EV charger. The maximum subsidy is ¥12 million for a single development. (The Nikkan Kensetsu Kogyo Shimbun, February 22, 2013; The Tokyo Shimbun, February 25, 2013)

(4) Osaka Prefecture and Others

To promote the next generation energy industry, Osaka prefecture and other participants announced additional areas for "Kansai Innovation Global Strategic Comprehensive Special Zone" have been approved by the prime minister. The expansion is 24 areas of 17.2 km^2 and includes; R&D on storage batteries and motors for EVs at the Nakamozu campus of Osaka Prefecture University in Sakai city, preparation of a large scale hydrogen infrastructure for FCV promotion at Kansai International Airport in Izumisano city and construction of a new power system with a solar power plant and storage batteries at Osaka Works of Sumitomo Electric in Osaka city. The local governments involved in the project aims to fortify their industries by expanding the special zone with the specially eased regulations and tax advantage. (Nikkan Jidosha Shimbun, February 25, 2013)

(5) Shiga Prefecture

Shiga prefecture developed the "Shiga Prefecture Renewable Energy Promotion Strategy" aiming at 1.06 GW of renewable energy to be used in FY 2030. The strategy intends to increase energy self-sufficiency and encourages residents and businesses to install renewable energy facilities. Also, cogeneration with natural gas and FCs will be promoted. (The Nikkan Kogyo Shimbun, March 15, 2013)

3. R&D for FC Related Element Technology

(1) Tokyo University of Pharmacy and Life Sciences

A study group within Tokyo University of Pharmacy and Life Sciences found out that two types of microbes living in soil cooperated with each other's energy production and metabolism, by transferring electrons through conductive particles. Reportedly, this discovery will support efficient bio fuel production, and be the base of development of microbial fuel cells. Geobacter sulfurreducens and Thiobacillus denitrificans, two common soil bacteria, were cultured in an environment containing acetic acid and nitric acid. Magnetite particles, conductive iron oxide, were added to the bacteria to examine electron flow and metabolism. Because plenty of conductive particles such as magnetite exist in nature, the group presumes that the two bacterial species have symbiotic relationship in their natural environment. (The Mainichi Newspapers, February 19, 2013)

(2) Kyushu University

A research group with Prof. Naotoshi Nakashima at Kyushu University developed a new catalyst which potentially extends a FC's life span by a factor of 10 times. The catalyst consists of stable carbon nanotubes (CNTs) with platinum nanoparticles attached on their surfaces to maintain high performance levels. CNT is a difficult structure to bond platinum nanoparticles to its surface. The group used polybenzimidazole (PBI), a special plastic, to glue the platinum. PBI also helps platinum to react more efficiently, which leads to a large reduction in expensive platinum usage in FCs. The method is planned to be applied to FCs as quickly as possible. Recently, carbon black has been used to support platinum as a conductive material. However, carbon black dissolves as the reaction goes, which brings FC performance down. (The Nikkei Business Daily, February 26, 2013)

(3) Osaka University

On February 27th, a research group with Prof. Hideaki Kasai of Osaka University revealed its results, at an international forum, that quantum tunneling strongly affected PEFC power generation. Hydrogen and oxygen reactions using catalyst in FC theoretically require a high temperature of several hundred degrees. However, these substances can react at a near room temperature in reality. This fact

attracted the group. They analyzed the transition of the reactions at an atomic level on a computer, and found out that the reactions was influenced quantum tunneling, where a particle tunnels through an energy barrier. With this theory, they changed the materials of the PEFC so that the phenomenon becomes more efficient. Reportedly, the battery exhibited better reaction rate of hydrogen and oxygen than a conventional PEFC. (The Yomiuri Shimbun, March 4, 2013)

(4) University of Tsukuba

Associate Prof. Kazuhiro Marumoto at the University of Tsukuba developed a process which helps to increase the life span of polymer solar cells largely. Artificial sunlight was directed at a solar panel to measure the accumulation of electric charge. The more electric charge accumulated, the more degraded the cells became. The result exhibited a clear correlation between the electric charge accumulation and deterioration. This finding can also be applied to FCs and organic transistors. Recent analyze methods could not specify where electric charge was accumulated, and the relation between the electric charge and the cell's degradation was unproved. Associate Prof Marumoto developed a new method "Electron Spin Resonance (ESR)". A dedicated solar simulator was prepared to operate a solar cell. Number of positive charge accumulations was accurately measured and the location of the accumulation was successfully found out at a molecular level during solar cell operation. (Dempa Shimbun, March 5, 2013; The Denki Shimbun, March 6, 2013; The Nikkei Business Daily, March 18, 2013)

(5) Tohoku University

A study group with Prof. Shinichi Orimo at Tohoku University and the Japan Atomic Energy Agency (JAEA) developed a new material which potentially functions as secondary battery and fuel cell. The material may be applied to the cathode, anode and electrolyte of a lithium ion battery (LIB) as well as hydrogen storage material for FC. The product is a perovskite-type structured compound comprised of three hydrogen atoms with a lithium and a nickel atom each. Compounds of lithium, nickel and oxygen have been known for years, and the new material has the oxygen replaced with hydrogen. The group believes lithium becomes a positively charged ion, and hydrogen, either as it is or strongly bonded with nickel, changes into a negatively charged ion. The combination of lithium, hydrogen, iron, cobalt and nickel was calculated by the computational chemistry method. Using lithium hydride and nickel, the material was produced as the calculated result. The material is a polycrystal with a particle diameter of slightly less than 1 mm. (The Nikkei Business Daily, March 13, 2013)

Prof. Yasuaki Kohama at the New Industry Creation Hatchery Center of Tohoku University developed a FC using magnesium. Used magnesium is reusable via solar energy. The prototype is 20 cm wide, 15 cm deep and 10 cm high, and generates electricity with a salt solution. A magnesium alloy sheet inside the shell works as an anode. Oxygen in air acts as a cathode, and these materials react with a sodium hydroxide solution. While the reaction creates electric current, the magnesium alloy changes into magnesium oxide. The prototype can operate a small TV for 30 hours or charge a mobile phone for 120 minutes. (The Tokyo Shimbun, March 18, 2013)

4. Bio Fuel Cell Development

Toyota Motor has accelerated the development of a bio FC which uses enzymes. Having increased its performance by optimizing the enzyme and electrode composition, the FC is predicted to gain a 400 W/kg energy density, which is the same level or higher that of LIB or PEFC. The enzyme works as a catalyst, and methanol is used to generate power in the FC. Because the FC's generation performance is lower than conventional FCs, the automaker aims to develop it for devices which require low power and run a longer time rather than powering a car with it. For breakthroughs, development of new dedicated materials for electrolyte membranes and electrodes for bio FC is essential. Offering a joint development to others such as material manufacturers, the firm aims to commercialize the product as soon as possible. (The Chemical Daily, March 15, 2013)

5. Ene-Farm Business Plans

(1) Hiroshima Gas

Hiroshima Gas aims at 370 unit sales of Ene-Farm generate from natural gas for the FY 2013, which is 50% more that of the FY 2015. Putting more effort to

sell the product for established houses, they will expand the range with lower priced FCs and a product which generates power during power cuts, to achieve the target. Since January, "W Chance Campaign" has been attracting consumers. The campaign offers Ene-Farm purchasers ¥105,000 for an old water heater as trade-in as well as ¥450,000 governmental subsidy for a purchase. (The Chugoku Shimbun, February 21, 2013)

(2) Sekisui House

On February 23rd, Sekisui House held an opening ceremony for its smart town "Smart Common City Hayashi-cho" in Hayashi-cho, Takamatsu city. This set of ready-built smart houses supplies its own energy and, is designed to be a next generation community withstanding disasters. The firm plans to install photovoltaic generators and FCs for all the houses and intends to provide storage batteries for 20% of them. (The Shikoku Shimbun, February 24, 2013; Jutaku Shimpo, March 5, 2013)

(3) Shizuoka Gas

Shizuoka Gas announced that its next generation carbon reduced residential area "Eco Life Square Mishima Kiyomizu", Mishima city, was awarded with a cogeneration grand prize from the consumer section by the Advanced Cogeneration and Energy Utilization Center Japan (ACEJ). The housing area aims to generate own its power on-site with Ene-Farms and photovoltaic generators, and receives attention as an industry-academia-government joint business method. ACEJ recognized the buyback program on CO_2 reduction and continues the energy advice of Shizuoka Gas. (The Shizuoka Shimbun, February 24, 2013)

(4) JX Nippon Oil & Energy

JX Nippon Oil & Energy started the operation of an energy system for the new management building and a new solar power plant at its Sendai Refinery, Tagajo city, Miyagi prefecture. The facilities, which were damaged by the tsunami of the Great East Japan Earthquake, were relocated to a higher part of the land, and a 1MW output photovoltaic generator was installed in the empty place. To be able to function during disasters, the management building is equipped with 15 kW of solar panels, a 0.7kW Ene-Farm, a 30kWh storage battery and a 104 kW diesel engine generator comprising the independent energy system. (The Denki Shimbun, The Nikkei Business Daily, March 5, 2013)

(5) Osaka Gas

On March 7th, Osaka Gas announced that a new experiment would start to examine energy sharing between households from June. Solid oxide fuel cells (SOFCs) will be installed in each unit, and unused electricity will be saved in a storage battery or sent to other households as required. The firm will investigate how efficient the system is for commercialization. The experiment will be carried out at Osaka Gas's apartment house "NEXT21" dedicated for research. The experimentation is the fourth phase of a research project, and the firm will have an operation test of a SOFC prototype aiming at 55% generation efficiency. (The Mainichi Newspapers, The Nikkei, March 8, 2013; The Denki Shimbun, March 11; The Nikkan Kogyo Shimbun, March 13, 2013)

On March 12th, Osaka Gas revealed its intention to introduce a smaller Ene-Farm, which will be engineered for apartment units based on conventional products for houses, in 2016. The sales targets are set at 10,000 units for Ene-Farm and 4,000 units for Ecowill in the management plan of the whole group for the FY 2013 which was also announced. "We aim to reduce the size installable in apartment units, like a gas boiler." said President Hiroshi Ozaki the press conference on the day. He emphasized the intention to accelerate the development of a small Ene-Farm which can fit in a little space such as a box for a gas meter and boiler (a closet size) at an entrance door of an apartment unit. Further down-sizing is required, because the firm already has a highly efficient small SOFC for apartment units, but they have been installed in houses. (The Mainichi Newspapers, The Sankei Shimbun, The Denki Shimbun, The Kyoto Shimbun, The Kobe Shimbun, March 13, 2013)

(6) Himawari Home

Himawari Home, Kanazawa city, opened a show house with double generation combining a photovoltaic generator and Ene-Farm. This two-story house has a 114 m^2 floor area, and Ene-Farm supplies electricity during bad weather. (The Hokkoku Shimbun, March 10, 2013)

(7) Aisin Seiki

Aisin Seiki has expanded its housing-related and energy related products (L&E) business using

expertise and technologies gained from its automobile part developments. SOFC Ene-Farm which has been available since last April is expected to be a core product of the L&E department, and the firm anticipates increased sales. They achieved the targeted temperature range by modifying the insulation and thermal exchange design of the hot modules to reduce the temperature distribution inside the FC stack, while satisfying energy conversion efficiency and durability standards. By this enhancement, the product is recognized as the top global level of energy conversion efficiency and durability of FCs. The product has been sold in the Kansai area through Osaka Gas since last April. The manufacturer started to supply to Toho Gas and intends to expand its sales channel to the major gas suppliers by FY 2013. (Dempa Shimbun, March 13, 2013)

(8) Nihonkai Gas

Nihonkai Gas now sells Ene-Farm for less than ¥1 million with subsidies. Targeting at 100 units for this year, they also aim to established houses as well as new houses. Toshiba's Ene-Farm is offered exclusive to the supplier's customers for ¥1.45 million including installation. A resident of Toyama city can receive ¥0.45 million from the government and ¥0.05 million from the city, which brings the total price to ¥0.95 million. (The Toyama Shimbun, March 13, 2013)

(9) Mitsui Fudosan Residential

On March 13th, Mitsui Fudosan Residential announced that the construction of a total of 21 ready-build houses to sell, "Finecourt Otsuka", had started in Toshimaku, Tokyo. All the houses will be smart houses with Ene-Farm, domestic storage batteries and home energy management (HEMS). Having light emitting diodes (LEDs), these passive houses use natural energy including wind and light as well as the other environmentally friendly devices. A maximum of 55% reduced of energy consumption is estimated compared to average households (The Nikkan Kogyo Shimbun, The Denki Shimbun, The Nikkei Business Daily, March 14, 2013; Nikkan Kensetsu Sangyo Shimbun, March 15, 2013)

6. FCV& EV Cutting Edge Technology

(1) Nissan & Tokyu

On February 19, Nissan Motor and Tokyu, a train operator, started a survey of a microcar "Nissan New Mobility Concept" with Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and Yokohama city. Seven vehicles are supplied to seven households with children in Tama-denentoshi area in Yokohama city along a Tokyu railway line. Usage in real lives will be researched to find issues to be solved before commercialization. The survey term is two weeks from March 4th. Nissan will lend them micro EVs with LIB which drive 100 km on a single charge. The vehicles have two seats, and the dimensions are 2340 mm long, 1230 mm wide and 1450 mm high. The maximum speed is 80 km/h. MLIT revealed guideline for microcars last June, and prepared a certification scheme to drive on public roads this January. The ministry has been designing a system for automakers to introduce microcars into the market. (The Nikkei, February 20, 2013)

(2) FCV Ran in Senshu International City Marathon

On February 17th, Toyota Corolla Nankai and Netz Toyota Nankai, car dealers, sent eight vehicles including the Prius PHV and the Vellfire HV and two fuel cell hybrid vehicles (PCHVs) for the 20th Senshu International City Marathon from Hamadera Kouen, Sakai city to Rinku Kouen, Izumisano city. These "environmentally friendly" cars accompanied the 4,000 runners. (Nikkan Jidosha Shimbun, February 22, 2013)

(3) Suzuki

A joint venture Smile FC System, Hamamatsu city, of Suzuki and UK-based Intelligent Energy (IE) has set up its FC production line at Suzuki's facility in Yokohama city. A test operation will be carried out to produce FC systems for motorcycles and automobiles in high volume. The lines use semi-automated production technology which is developed and utilized by IE in the UK. This technology is associated with the reduction of manufacturing and assembly costs and enhanced product quality, which accelerates development and commercialization of Suzuki's FCV, and is a good step for commercial production. (Nikkan Jidosha Shimbun, February 23, 2013)

(4) Nissan Motor

On February 26th, Nissan Motor made an announcement of expanding global motorsport program. "GT-R" was added to Nissan Motorsports International (NISMO)'s flagship series which is a

performance class sports car range. The automaker will enter the world's harshest race the Le Mans 24 Hours in 2014, with electric technology incorporated vehicles to promote Nissan brand. (The Nikkei, February 27, 2013)

(5) Hyundai Motor

On February 26th, South Korea-based Hyundai Motor announced that production of the FCV "iX35 Fuel Cell" had started. Using SUV " iX35, a Segment-C car as its base, this FCV has a 70 MPa tank accommodating 5.6 kg of hydrogen, and can drive 594 km on a single charge. The maximum speed is 160 km/h. The automaker will display the car in the Geneva International Motor Show. Local governments in Europe have already ordered 17 cars of "iX35 Fuel Cell". Hyundai plans to produce 1,000 vehicles by 2015 which will be leased to European local governments. The production for consumers is planned from 2015. (Nikkan Jidosha Shimbun, February 28, 2013)

(6) Yamato Transport, Toyota Motor, Hino Motors

On March 1st, Yamato Transport, Toyota Motor and Hino Motors announced that a test run of a small EV truck would start in March. The EV truck is used for short-distance transport in an urban area, with a 20 to 30 km driving range each day. The firms will examine the cost reduction and battery performance by switching from diesel to electricity. The result will be used for pricing and further development of the vehicle. Having a 1 ton load capacity, the EV truck accommodates freezer and fridge compartments at the back, which allows Cool TA-Q-BIN, refrigerated delivery service. A single charge gives an approximately 100 km drive, and the motor is stored under the driver's seat. The truck bed is 44 cm from the ground, half the height of a conventional truck, which hopefully helps for an efficient unloading process. (The Nikkei, The Sankei Shimbun, Fuji Sankei Business i, March 2, 2013)

(7) Geneva International Motor Show

Automakers will display a total of 900 vehicles including 100 new models in the Geneva International Motor Show from March 5th. This year is "the first year for eco car in Europe" due to the beginning of volume production of EVs by auto giants such as German-based Volkswagen and BMW. The motor show will be full of new small EVs and plug-in hybrid vehicles (PHVs) incorporating the most advanced environmentally-friendly technologies. (The Nikkei, March 5 , March 6, 2013)

(8) Toyota Motor & Mitsubishi Motors

Toyota Motor's concept car, a two-seater small three-wheeler EV "i-ROAD", made its first appearance in the Geneva International Motor Show. Providing casual mobility like a motorcycle, the vehicle helps to solve urban issues such as traffic congestion and a shortage of parking space. On March 5th, the automaker also announced that a car-sharing experiment with small EVs would be carried out in Grenoble for three years from the end of 2014 with other firms including Électricité de France (EDF). The residents may use the EV for short travel from a train station or bus stop to their final destination. Toyota will supply approximately 70 small EVs and a booking system through smartphones. EDF will install and operate recharge stations, and France-based Cité lib, a car-sharing service operator, will cooperate for the operation. Mitsubishi revealed two new concept cars which are small EVs with an extended driving range, 300 km on a single charge, the first in the motor show. (The Nikkei, March 5, March 6, 2013)

(9) University of Yamanashi

FC with new technology developed by the "Fuel Cell Nanomaterials Center" of University of Yamanashi cleared a basic performance test conducted with an automaker. The result shows an improvement of FC's durability and reaction rate, which is substantial progress for the commercialization of FCVs with Yamanashi brand technology. Automakers plan experimentations and driving tests for commercialization with the technology provided by the center. FCVs are expected to become very common from 2020 initially, but the progress may shorten the outlook two to three years. (The Yamanashi Nichinichi Shimbun, March 5, 2013)

7. Technology Developments and Business Plans for Hydrogen Refueling Station

(1) Kobe Steel

On February 26th, Kobe Steel announced a new hydrogen filling compressor and compact heat exchanger suitable for hydrogen filling station accommodating 70 MPa high pressure refueling for

FCVs. The compressor can achieve hydrogen flow rate of 1200 Nm3/h, which is the highest level in Japan. This product allows significantly reducing filling times for FCVs. The heat exchanger refrigerates hydrogen strongly heated by the compressor, and is used to cool the compressor and dispenser which supplies hydrogen to compressor. Significant size reduction was achieved by the non-welding technology, diffusion bond, which allows the heat exchanger to withstand higher pressure. These products were delivered to a hydrogen refueling facility in a petroleum filling station, operated by JX Nippon Oil & Energy, in Ebina city, Kanagawa prefecture. The compressor can fill a FCV in three minutes, and the heat exchanger only requires a space of approximately one thirtieth to hundreds that of conventional products. (The Nikkan Kogyo Shimbun, Japan Metal Daily, February 27, 2013; The Chemical Daily, February 28, 2013; Nikkan Jidosha Shimbun, March 1, 2013; The Denki Shimbun, March 4, 2013)

The Machinery Business of Kobe Steel has developed a new testing device for metallic materials which withstands highly pressurized hydrogen. Using technology the super high pressure critical system of Kobe Steel, the testing device measures tension strength, toughness and durability of stainless steel and special steel. The firm targets steel manufacturers and research institutes for the sales. (Japan Metal Daily, March 1, 2013)

(2) Mitsubishi Kakoki

Mitsubishi Kakoki developed a new compact hydrogen generation plant "HyGeia-A" which is a highly efficient producer for refueling stations, and has introduced the product into the market. Using a conventional product as the base, the plant offers improved energy efficiency, lower cost and reduced size. The manufacturer plans to deliver the first product to a hydrogen refueling station by the end of FY 2012. (The Chemical Daily, February 28, 2013)

8. Hydrogen Production/Refining Technology Developments

(1) Kobe Steel

Research and Development Laboratory for Machinery of Kobe Steel has developed a new production and refining system which flexibly creates hydrogen in high volume. The system was developed with Kobe Steel's original technology to fit catalysts such as nickel, aluminum oxide and platinum in the reformer, and uses CO capturing technology developed from steel work expertise. These enhancements together allow a reduction in hydrogen production time. Catalysts are placed in a tube shaped reformer which is heated by an external burner with conventional "steam reforming" technology to produce hydrogen. However the tube potentially bursts due to high temperature of approximately 800 °C, which causes slow start of the production and refining system. To solve this, the firm uses oxidation catalysts such as nickel which reacts and heats itself inside the reformer rather than using an external heat source. This ATSR reforming allows the system to reach temperature faster. Because CO is impeditive for hydrogen production, a capturing method from steel work expertise is also applied. (Japan Metal Daily, February 27, 2013)

(2) Japan Atomic Energy Agency

Japan Atomic Energy Agency (JAEA) are developing a "Thermochemical Water-splitting Iodine-Sulfur Process (Thermochemical Water-splitting IS Process)" to extract hydrogen from water using iodine, sulfur and approximately 900 °C of heat from a high-temperature gas reactor. Water is sent underneath the reactor to bond hydrogen with iodine and oxygen with sulfur. Heat between 400 and 900°C is applied to these chemicals to extract hydrogen and oxygen. Hydrogen is to be used as a fuel, and along with iodine and sulfur go back into the cycle. The agency developed a radiation-grafted polymer electrolyte membrane to efficiently separate and concentrate hydrogen from a hydrogen iodide solution. The thermal efficiency of the hydrogen production is increased by around 40%, double that of electrolysis, by reducing the energy needed to concentrate it. Experimental scale hydrogen production succeeded in 1997, and JAEA are now creating a fundamental technology with industrial materials, and plans to make three chemical reaction devices by the end of FY 2012. After these devices are connected as a system, soundness of the system will be analyzed by FY2015. Using this basic technology, MITI and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) will develop a hydrogen production method, with solar heat instead of the high-temperature gas

reactor, from FY 2013. (The Denki Shimbun, March 7, 2013)

9. Hydrogen Storage Technology Development

A study group with Prof. Zenji Horita at the Kyushu University developed a new material which would reduce the cost of hydrogen storage alloy to a twentieth that of the conventional method. Specially processed iron and titanium alloy is used to store hydrogen instead of expensive rare earth alloy. Hydrogen storage alloy commonly uses lanthanum, a rare earth element, and nickel; however, these costly materials cause a price issue. (The Nikkei Business Daily, March 1, 2013; The Nikkei, March 7, 2013)

10. R&D / Production Plans and Activities

(1) Tanaka Kikinzoku Kogyo

On February 26th, Tanaka Kikinzoku Kogyo announced that a plant exclusively for the manufacture of PEFC electrode catalyst would be constructed in the Shonan Plant and it would operate fully from August. Currently, the Hiratsuka Technical Center has research and development, quality control and shipping functions for FCs, and the new plant will take over all these functions. Approximately ¥1 billion is invested. (The Nikkei Business Daily, The Nikkan Kogyo Shimbun, Kanagawa Shimbun, The Chemical Daily, February, 27, 2013; Dempa Shimbun February 28, 2013)

(2) TeraDai

TeraDai, Saitama prefecture, will start a voluntary association "Higashinippon Semi-solid Technology Development Center (SSC)" from April with Tohoku University and six die-cast manufacturers. The association will promote new technology and products of semi-solid metal casting. A separator for FCs made by aluminum die castings is planned as the first pilot product. (The Nikkan Kogyo Shimbun, February 27, 2013)

(3) Sumitomo Metal Mining

On March 11, Sumitomo Metal Mining announced that a pilot plant to collect scandium, a rare earth element, would be constructed at its subsidiary, a factory in the Philippines. The factory produces nickel and cobalt mixed sulfide, and the raw ore contains a tiny amount of scandium. Sumitomo Metal Mining developed a technology to extract the element efficiently during the process, and plans to start the pilot plant with the technology by the end of 2013. Scandium is mainly produced in the US, Ukraine, Russia and China, and its production is estimated around 10 ton annually. Because scandium is expensive and its production is low, the application is currently limited. However, the element is strongly expected to be used for electrolyte and an additive to aluminum. (The Denki Shimbun, The Nikkan Kogyo Shimbun, The Ehime Shimbun, The Chemical Daily, March 12 ,2013)

11. Market Prospect

On March 12th, Fuji-Keizai released its report showing the global FC system market would expand to ¥5.1843 trillion, 74 times that of FY 2011, by FY 2015. The industrial and business use product market is expected to grow to ¥0.7341 trillion, approximately 20 times that of FY 2011. Because FC systems have high generation efficiency, they are affordable for smaller businesses. Currently 2.8 MW level systems are commercially produced. Domestic FC market is estimated to increase to ¥1.119 trillion, 70 times that of FY 2011. Ene-Farm ranges have been available since 2009 in Japan, and the European market for domestic FCs hopefully grows. The FCV market is expected to increase to ¥2.9106 trillion by FY 2025 from ¥0.0003 trillion of FY 2011. FCVs are used for experiment and leased at the moment, and commercial FCVs are planned to be fully available from FY 2015 in Japan and South Korea. Additionally, more hydrogen refueling stations are expected to be constructed worldwide. (The Nikkei Business Daily, March 13, 2013; The Nikkan Kogyo Shimbun, March 15, 2013; Nikkan Jidosha Shimbun, March 16, 2013)

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