

ENE-FARM continues operation even during power failure

Arranged by T. HOMMA

1.National Policies

APEC, consisting of 21 Pacific Rim countries/regions, is going to hold a ministerial meeting among foreign ministers and trade ministers at the White House in October and November. At working-level consultations held in advance, Japan and the US suggested that the tax for solar power generation and environment-related equipment such as FC should be lowered below 5% by 2015 and negotiations with China and other emerging countries which are cautious for the tax reduction are going on. Within APEC, China imposes customs duties of 14% on imported FC, Indonesia likewise 10%. Some countries impose the tax on wind power generation and smart meters (The Nikkei, November 11, 2011, the Yomiuri Shimbun November 11, 2011).

2.Local Government Policies

(1) Saitama City

Saitama City is going to make a partnership with Toyota to promote EVs and FCVs. Toyota in turn is going to join with “E-KIZUNA” that the city is pushing forward. They will conclude an agreement on October 27. The city has been promoting the installation of battery charger for EV, introduction EV purchase support, and conversion of official vehicles into EVs. They also cooperate in the area of FCV as to promotion and installation of hydrogen refueling stations. (The Nikkei Business Daily, October 26, 2011, The Nikkei/the Nikkan Kogyo Shimbun/Nikkan Jidosha Shimbun/Fuji Sankei Business i, October 28) Saitama City held “The 2nd E-KIZUNA Summit” at a hotel in Saitama City on November 11. Twelve companies including Toyota and Nissan and 22 local governments including Aomori City and Sendai City attended the summit meeting. (The Nikkan Kogyo Shimbun, November 11, 2011)

(2) Chiyoda Ward, Tokyo

Chiyoda Ward hosted a briefing session on October 26 to explain about “Green Stock” operation currently in promotion to make all the existing facilities in the ward energy efficient to cope with global warming and about 40 residents attended. The operation aims to conduct energy audit and consequently to promote installation and operational improvement. The ward is going to grant a certain amount of financial aid as repair expense to those who are approved to install apparatus such as solar power generation, FC system and LED. (Construction Daily Newspaper, October 28, 2011)

(3) Toyota City, Aichi Prefecture

Toyota City made an application for “Comprehensive Community Revitalization Zone” to the government in order to accelerate the projects related to environment, transportation, and industry. The city aims to build an environmental futuristic city integrating safe/comfortable transportation and energy technique such as development promotion of energy-saving technique utilizing next-generation vehicles and smart grid and spreading/expanding them based on the “FutureCity” initiative implemented by the government. (Nikkan Jidosha Shimbun, November 9, 2011)

3.FC element technology development

(1)Yamanashi University

Professor Haramoto et al. of Yamanashi University has successfully developed electrolyte material that could activate PEFC (polymer electrolyte fuel cell) even at 30 degrees below zero. The electrolyte material is 2.5 nm long organic molecules assembly and hydrogen ions move between the molecules when voltage is applied. When the traditional electrolyte material is dissolved in water, organic molecules carry hydrogen ions, so once water freezes organic

molecules also freeze and then hydrogen ions would not move. (The Nikkei, October 31, 2011)

(2)Materials/materials research organization

National institute for Materials Science (NIMS) has decided to increase the durability of FC (fuel cell) and to focus on the establishment of synthesis technology of reduced-form titanium oxide. It has successfully transformed only the crystalline structure of titanium dioxide into reduced-form titanium oxide while maintaining the size and the shape of it. Calcium hydride was used to keep the titanium dioxide nanostructure. Having high electron conductivity as compared to carbon materials, the application study of this reduced-form titanium for FC electrode materials oxide is going to accelerate. Electrode materials having high corrosion resistance and the surface area with large nanostructure is essential for the performance improvement of FC. This electrode is usually made from carbon materials, but reduced-form titanium oxide is stronger in durability than carbon materials and is known as having high higher in which is known to have high conductivity and visible light absorption property. However, there has been a problem in the current synthesis process because the reduction of titanium dioxide is processed at about 1000 degree Celsius, resulting in problems such as enlargement of the particles and difficulty of obtaining nanostructure. With these backgrounds, NIMS has focused on the method to disconnect oxygen at low temperature and has studied on the reduction of titanium dioxide materials having a rutile crystal structure by utilizing calcium hydride with a strong reducing power even at low temperatures. As a result, NIMS has succeeded in transforming only the crystalline structure of titanium dioxide into reduced-form titanium oxide. The surface condition, which is critical for chemical durability, was confirmed to be covered with natural oxide film of titanium dioxide. Reportedly, reduced-form of internal oxide is maintained in a stable condition. From now on, NIMS plans to conduct experiment to demonstrate the performance of electrode materials made from reduced-form titanium oxide obtained by the same method, and aims for higher performance and stronger durability of FC. (The Chemical Daily, November 4, 2011)

(3)Syvec Corporation and others

Consortium, composed by Syvec Corporation (Shiojiri City), SUN-KK Corporation (Ina City) and IHI Shibaura (Matsumoto City), announced on November 18 that it started demonstration experiment of industrial FC at the plating plant of SUN-KK. Reportedly, the weight is 40% of the existing FC and the production cost decreased by 20%. They continue the experiment until the year end and accumulate the data of power generation efficiency and waste heat efficiency, and aim to commercialize it by around 2015. One of the characteristics of the FC developed by the consortium is that the separator, the main parts, is made of titanium. Compared to the existing one made of carbon, the cost of the newly developed separator is one tenth and 20% of cost of whole FC production could be reduced. From now on, based on the experiment result, they embark on the early commercialization. They also continue the study with automobiles and tractors in perspective of usage combining with storage battery. IHI Shibaura intends to “increase power generation capacity to 10kW”. (The Shinano Mainichi Shimbun, November 19, 2011)

4.Result of the development of SOFC

The research group, led by Mori, of Nano-materials environmental science base of NIMS, announced a new model that defect structures in an electrolyte is formed in shape of dumbbells which affects the durability of SOFC. This model well explains the mechanism of deterioration and will reportedly lead to a development of a new material to realize the long-term stability of SOFC. SOFC generate electricity when the oxide ions go through in the electrolyte, but after running for a long period of time, the crystal structure changes its nature from easy-to-penetrate to hard-to-penetrate for the oxide ions, which is said to lead to the deterioration of the performance. This time, the high-performance materials and highly deteriorated materials were analyzed by electron microscopy and simulation analysis for the defects in the crystal to structure a new model in which the triangular defects overlaps in a dumbbell-shaped structures. It says that when the dumbbell-shaped structure develops overlapping each other, it well fits with the characteristics of the crystal structure with hard-to-penetrate nature. Originally it was thought that the defect structure had a straight

chain structure, but this model was not able to explain the phenomenon of the change of crystal structure. According to the research group, the dumbbell-shaped defect structure was formed by the slightly uneven distribution of the additive agent at the atomic level used to introduce the defect structure into the crystal, which incurs the variations in performance and made it difficult to establish the trust. (The Nikkan Kogyo Shimbun, November 11, 2011)

5.ENE·FARM Business Development

(1)Japan Gas Association

Chairman Torihara of Japan Gas Association announced on October 27 that the goal of dissemination of natural gas-related equipment for 2030. It has enhanced cogeneration from current 4,600 to 3,000 M kW, gas air conditioning from current 13,000 to 26,000 M refrigeration ton, family-use FC from 20 to 5,000 M sets, which assume 15 % of total annual electricity demand and eventually could save 13,000 M kW of the peak power. (The Nikkan Kogyo Shimbun, October 28, 2011)

(2)JX Nikko Nisseki Energy, Heisei, Western Gas Energy

JX Nikko Nisseki Energy, Heisei (Itoshima City) and Western Gas Energy announced on October 28 that they have agreed to open a smart house in Fukuoka Hydrogen town in Itoshima City, Fukuoka Prefecture. It would be equipped with SOFC-type of Ene Farm, solar energy, storage system and energy display monitor. Usually, it would use Ene Farm, solar power and system power in this order, but at power failure, it would stand alone from the system power and supply electricity from Ene Farm and storage system in this order depending on the energy consumption. They aim to open up the house at next summer after utilizing the result of demonstration experiment. (The Chemical Daily, October 31, 2011, the Nikkei Business Daily, November 4, the Nishinippon Shimbun, November 8)

(3)Tokyo Gas

Tokyo Gas announced on November 2 that it succeeded in developing a power generating system using Ene Farm that would continue operation even at a power failure in collaboration with Seiko Electric Co., Ltd. Ene Farm needs a stable amount of electricity to generate electricity, so it lost power at the

East Japan Great Earthquake due to the planned outage. Tokyo Gas and other companies made it possible to continue generating electricity by new Ene Farm with external batteries combined. It would start the service from February 2012. The substantial purchase cost would be 3 million yen including the subsidy for the new system. It can be post-installed near existing Ene Farm. An emergency such as blackout, it can supply minimum electricity for 24 hours for necessary articles such as lighting, TV, refrigerator at each household. (The Yomiuri Shimbun, the Asahi Shimbun, the Nikkei, the Denki Shimbun, the Nikkan Kogyo Shimbun, Fuji Sankei Business i, November 3, 2011, the Nikkei Business Daily, November 4, 2011)

Tokyo Gas announced November 15 a long term plan aiming for 2020 on November 15. In order to cope with the shortage of electricity, it will double the domestic thermal power generation from current to 500 million kW at the most. Also it has set a goal of 300 M sets of Ene Farm, thirty three times of increase from the current. (The Yomiuri Shimbun, the Denki Shimbun, the Nikkei Business Daily, Fuji Sankei Business i, November 16, 2011, Architectures, Constructions & Engineerings News (Daily), November 17)

(4)Daiwa House

The construction of “Ambitious Hill”, the new company house of Yamatani Sangyo, has just been completed at Nonoichi City in Ishikawa Prefecture. Daiwa House was in charge of the design and construction. It was Eco-friendly office building equipped with Ene Farm, solar electric generation system, wind power electric generation system, and was assessed as S rank by overall performance assessment system for building environment. (Nikkan Kensetsu Sangyo Shimbun, the Hokkoku Shimbun, November 10, 2011, the Chemical Daily November 11)

6. The latest news of the next generation Eco car

(1) Nissan Motor

Nissan Motor announced on October 24 that it will release PHV that can be charged by home electricity by 2015. It has included “Mid-term environmental action plan” focusing on 35% of reduction of the average fuel consumption vs. 2005 by 2016 for cars to be sold in Japan, China and Europe. In addition to

Leaf in the preceding EV category, seven new types of cars are going to be developed with Renault, the parent company, and will sell a total of 150 million cars by 2016. Also, Nissan will proceed to the co-development of FCV with Daimler. (Yomiuri Shimbun, Asahi Shimbun, Mainichi Shimbun, Nihon Keizai Shimbun, Nikkan Kogyo Shimbun, Daily Automotive, Tokyo Shimbun, Kanagawa Shimbun, the Shizuoka Shimbun, the Chunichi Shimbun, the Nishi Nihon Shimbun, Fuji Sankei Business i, the Chemical Daily, the Kahoku Shimpo, October 25, 2011)

Nissan Motor is going to reveal EV "PIVO-3" at Tokyo Motor Show to be held in December. The car can be left at designated places to be charged and parked automatically. After driving, the car is going to be shift into automatic driving and goes to the designated parking lot to stop and charge. After business, drivers can call the car forward by operating a smart phone from a designated place. The car automatically moves forward. It has adopted the in-wheel motor to have a small turning circle as an urban use EV. The rotation angle is 75 degree, which is wider than the normal by 50%, enabling to make a small U-turn even at a narrow road with only 4 meters of width. The car is compactly designed to accommodate one person in the front seat and two in the rear seat. (The Nikkei, November 9, 2011)

(2)Honda

Honda has started a demonstration experiment of EV at Guangzhou, China on November 8. It will research performance and charging infrastructure suitable for China's urban environment using "Fit" as a base car. The result is going to be applied when Honda starts joint production with Guangzhou Automobile Group in 2012. Experiment car runs 150 km per one electric charge, and charging time is less than 6 hours for 220V. (The Nikkei, November 9, 2011)

(3)Suzuki

Suzuki is going to exhibit 23 next-generation compact cars including "Regina". A 2.5 m of two-seater EV "Q-Concept" is going to be presented for transportation within a 10 km radius of life range. Focusing on "SWIFT", "SWIFT EV Hybrid", "FC scooter" and "BURGMAN FUEL CELL SCOOTER" which are equipped with electric motors and engines for power generation to supply electricity are also

going to be exhibited. (The Nikkei, The Shizuoka Shimbun, November 9, 2011)

(4)Mitsubishi Motors

Mitsubishi Motors announced on November 9th the exhibition overview for Tokyo Motor Show. In addition to "Mirage" positioned as a new compact car in the global marketing strategy, "MITSUBISHI Concept PX-MiEVII" originally developed from EV-derived PHP is going to be exhibited for the first time. "MITSUBISHI Concept PX-MiEVII" is Eco-friendly SUV intended for more than a middle-class car. It can be equipped with battery driving mode or battery charging mode which enables to charge while driving, and can supply electricity to home. Mitsubishi aims for 60 km/L of composite fuel consumption, that is, combination of fuel consumption rate of electric driving and that of hybrid driving. (Nikkan Jidosha Shimbun, November 10, 2011)

Mitsubishi Motors has decided to provide Suzuki with EVs as OEM. It is a light commercial vehicle "MINICAB-MiEV", the 2nd EV from Mitsubishi. They will soon come to an agreement. Mitsubishi is expecting needs as distribution cars such as a courier company and targeting at 4,000 cars of production in 2011. Suzuki plans to supply the cars as their own-brand to their sales network and is going to expand sales according to the trend. (The Nikkei, November 22, 2011)

(5) Daihatsu

Daihatsu Motor has announced on November 9th three kinds of concept cars such as "D-X" to exhibit at the Tokyo Motor Show. Other than these, a two-seater EV "PICO" and FCV "FC SHOW CASE" are going to be exhibited. "PICO" is going to be presented as a new vehicle for a short transportation or home-delivery business in the city. FC of FCV will be generated by liquid fuel hydrazine hydrate. It is reportedly suitable for business since FC is equipped under the floor, which increases the design freedom. (The Asahi Shimbun, Nikkan Jidosha Shimbun, Fuji Sankei Business i, November 10, 2011, The Nikkei Business Daily, November 11, 2011)

(6)Demonstration experience of a small electric car

A demonstration experience of a two-seater small electric car is going on in Yokohama City. Citizens in a limited area is going to co-use a car and the CO2 reduction effect and usage status by the elderly and

house wives are going to be investigated. Effectiveness as a means of going around the sightseeing area will be investigated and the result will be reflected in the policy. The same kind of experiment is going to be held in Aomori and Fukuoka Prefecture. The compact car with only 119 cm of front width was developed by Nissan Motor. "Easy to drive and easy to turn around. It helps because there are a lot of slopes around here", says a test rider. (The Nikkei, November 16, 2011)

(7)Toyota Motor

Toyota Motor announced on November 15 the exhibition overview for Tokyo Motor Show. They are going to exhibit FCV "FCV-R" and urban-style EV "FT-EV III" for the first time. Other than these, they will also exhibit "Prius PHV" for the first time in Japan and compact-class HV model "AQUA" for the first time in the world. "FCV-R" is going to be presented as highly practical FCV-specific car to be introduced in the market at around 2015. (The Sankei Shimbun, The Nikkei, The Nikkei Business Daily, Nikkan Jidosha Shimbun, the Tokyo Shimbun, the Chunichi Shimbun, Fuji Sankei Business i, November 16, 2011)

(8)The participation from foreign companies for the 42th Tokyo Motor Show

Audi Japan is going to exhibit an EV "A1e-tron", now under development. The company disclosed the car on November 17 in Kanagawa Prefecture for the first time in Asia and appealed its high performance as EV. VW is also will bring in EV microbus and an EV based on the leading model GOLF. Mercedes-Benz will highlight "F125!" to be mass produced in 2025 or later and a compact car "SMART" to be on sale in 2012. (The Hokkaido Shimbun, November 18, 2011)

(9)Sekisui House

Sekisui House announced on November 18th the exhibition overview for Tokyo Motor Show. Sekisui is going to exhibit the next generation-type "Smart House", which is incorporated with EV as well as equipped with three batteries system "green fast hybrid", namely, solar power generation, FC, and storage battery. Sekisui will also exhibit HEMS that is useful for inhibition of energy costs of house and car. (Nikkan Jidosha Shimbun, November 19, 2011)

(10)NTN

NTN has started negotiation with Japanese or Chinese auto manufactures to discuss supply of the

next generation vehicle EV and FCV. It has already started assessment experiments with several companies. NTN plans to get into the mass production of several parts including "in-wheel motor system" within 2 to 3 years which drives four wheels separately with the built-in in-wheel motors attached to tires. (The Nikkan Kogyo Shimbun, November 21, 2011)

7.Development of a new type of FC

(1)Microbial FC

Associate Professor Hibino of Hiroshima University Graduate School and his study team is now working on microbial FC using the system of microorganism to decompose the sludge in the river or the sea. He plans to lighten up LED illumination using this system on the right bank of Kyobashi River in December. It consists of 14 plastic cylinders (diameter: 12 cm, height: 25 cm) with electrode materials such as carbon fibers. The lower half part is going to be buried in the sludge. When a microorganism decomposes organic matters, protons are produced which can be transformed into electricity by retrieving with the electrode. From now on, they will proceed with the study to enhance the power generation efficiency and durability of the facility. (The Chugoku Shimbun, October 28, 2011)

(2)Ethanol fuel cell

Coding Eye, an eco-venture company (Gifu Prefecture), has successfully developed "ethanol FC system". Coding Eye is planning to introduce the product for general household by 2012. The company provides companies with their original know-hows developed in-house to produce bio-ethanol through enzymatic saccharification, fermentation, and distillation by using the plant wastes including cellulose such as papers and plants. The company focused on FC to broaden the use of target of ethanol. They will mainly use FC produced by Ballard Power Systems Inc. in Canada, and incorporate know-how of Coding Eye to modify to generate electricity with ethanol. Housing complex with about 300 households currently under development by Shiga Prefecture has decided to adopt the system and now the installation to the model house is going on. (The Gifu Shimbun, November 9, 2011)

8. Mobile FC development and business operation

A FC venture company Aqua Fairy (Kyoto Prefecture) and Kyoto University has agreed to co-develop mobile FC which uses slaked lime (calcium hydroxide) as fuel. They are assuming the use as a mobile phone battery charger or lighting power for outdoor activity just in case of emergency. Slaked lime is available at a reasonable cost, which is expected to cut down the cost of FC and eventually the cost of the product. They aim to commercialize it by the end of 2012. FC uses hydrogen gas generated in the course of reaction of aluminum and water, while aluminum is prone to oxidize under natural conditions and oxide film interfere with the generation. Sodium hydroxide (caustic soda) is commonly used to remove the film, but is not suitable for battery that needs durability and stability in the generation because the chemical reaction proceeds at once. Professor Hirao and his research staff confirmed for the first time in their experiment that slaked lime removes the oxide film gradually. The oxide film peels off when reacting with hydroxyl group in calcium hydroxide. Based on this knowledge, they will begin developing FC fuel including slaked lime and aluminum. They will prepare special water containers and fuel cartridges to develop the battery to irrigate during the generation mechanism. (The Nikkei Business Daily, November 2, 2011)

9. Development of resilient gas stations

Nikko Nisseki Energy has decided to set up resilient gas stations across the country. Under the assumption of utilizing gas stations as the emergency operation centers, they will deploy new type of gas stations, in which fueling is possible even if submerged with water and automatic generators and FC are equipped, at 12 bases nationwide where there might be a concern of tsunami disaster. National Federation of Agricultural Cooperative Associations and Idemitsu Kosan Co., Ltd. are also expediting to construct a network of gas stations that are useful in disasters. It is estimated that about 100 million yen (1.5 times as usual) of investment is needed per one station. (The Nikkei, November 11, 2011)

10. Research and development of hydrogen generation and purification

(1) Ehime University

Professor Nomura and his study team in Ehime University Graduate School of Science and Engineering have succeeded in experiment in driving a car using hydrogen extracted from waste oil. They overcame the problem of removing impurities from the hydrogen extraction, and proceeded to commercialization. The professor had succeeded in 2006 in extracting hydrogen by decomposing the waste oil in-liquid plasma. It has an advantage of solidifying the carbon fraction in the waste oil at the same time of extraction of hydrogen. The team has been studying to generate clean energy from waste oil. They succeeded in removing impurities in the process of five steps. They improved the purity up to 99% by using liquid nitrogen to liquefy other than hydrogen gas and alloy to absorb hydrogen. The experiment was conducted last September at the head office factory of Matsuda using a hydrogen rotary engine vehicle. The vehicle ran 360 m at 10km/h using 150 to 200 L of hydrogen extracted from 150 mL of waste oil. The professor says, "We are aiming to realize a society where we can store hydrogen from the household waste oil and obtain energy on a local production for local consumption basis". (The Ehime Shimbun, October 29, 2011)

(2) Okayama University

Taguchi Associate Professor and his team in Okayama University Graduate School of Environmental Studies announced that they succeeded in developing a new carbon nanotube photocatalyst which efficiently produce hydrogen from water by using visible light of the sun. The efficiency of hydrogen generation using visible light (wavelength: 450 nm) is 31%, which exceeds the 30% guideline for industrial use. The new photocatalyst has four-layered coaxial cable structure. It is made by adding proprietary chemicals to carbon nanotubes of carbon microfiber, followed by giving ultrasonic vibrations, then by coating the surface with molecular complex including fullerene C60, and finally by color coating the standing-out polymer surface. The research team dispersed photocatalyst involving 0.5 mg of carbon nanotubes into 150 mL of water before irradiating with visible light, resulting in a chemical reaction in which water was decomposed and 0.15 cm³/h of hydrogen, 31 % of absorbed light energy, was

generated. Generation of hydrogen was confirmed by ultraviolet light as well. (The Sanyo Shimbun, November 18, 2011)

11. Development of FC/hydrogen-related instrument and business development

New Cosmos Electronics (Osaka) has developed "PD-14", a suction gas detection unit for hydrogen station, which can measure even less than 1,000 ppm of ultra-low concentration of hydrogen that leaked. It has passed the criteria for hydrogen explosion for the first time in Japan. The selling price is 175,000 yen, and is on sale from December 2012. High-pressure gas safety law was modified last year end, and hydrogen leak check about a hose, when working on hydrogen supply by connecting a hose to FCV in the hydrogen station, has become a requirement. This led to the increasing demand of instrument that can detect even a smallest amount of hydrogen, and the market leaders had been preparing for commercialization since last year. (The Chemical Daily, November 4, 2011)

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A POSTER COLUMN

JOGMEC confirmed the presence of platinum and others in the north of South Africa.

JOGMEC (Japan Oil, Gas and Metals National Corporation) confirmed on November 10th the presence of platinum and others at the drilling site in the north of South Africa where they were conducting a research in collaboration with a coal mining company in Canada. At 643 to 646 m deep underground, an average of 3.47 g of platinum, palladium and gold were contained in 1 ton per sample. Depending on how widely distributed, it can lead to commercial production. Platinum group metals are used for FC electrodes in addition to automotive exhaust components. (The Asahi Shimbun, The Nikkei Business Daily, Japan Metal Daily, November 11, 2011)

Experiment of wireless power transmission for EV

US semiconductor giant Qualcomm held a technical briefing on the wireless power transmission for EV in Tokyo on November 22th. Qualcomm set a goal to develop technologies to transmit high-power

electricity wirelessly, and will start an EV demonstration experiment in London starting from 2012. They will use EVs of Citroen.

Wireless power transmission does not use neither electric cords nor plugs, but generate electricity by using two coils for transmission and receiving, and supply electricity to remote places. Electricity supply is available at 3kW, 7kW and 18kW or over, and can be received by embedding transmission equipment in a parking lot or a drive way and installing power reception equipment in a car. Transmission efficiency, which indicates the ratio of received electricity by an EV battery against transmitted electricity, can achieve more than 90 %. British Prime Minister Cameron also visited the facility or cars. (The Nikkei, November 23, 2011)