

HYDROGEN AS ALTERNATIVE FUEL FOR MOSCOW AND MOSCOW REGION

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Introduction

At present time Moscow Committee on Science and Techniques according to Moscow Government Programs started several new projects on hydrogen energy for Moscow and Moscow region. As rather large attention is paid to development of hydrogen powered vehicles, there is real necessity in development of hydrogen infrastructure (re-fueling stations for cars etc).

Development of hydrogen technologies

Today most of automaker companies prepare for output automobiles on fuel cells. In the framework of program of Moscow Committee on Science and Techniques for improvement of the ecological situation in Moscow and Moscow Region is developed an automobile on the basis of truck "Bychok". As a power plant it is planning to use in it the electrochemical generator on basis of PEM fuel cell, being developed in HEPTI RRC "Kurchatov Institute". Laboratory models of PEM fuel cell stack with power up to 1 kilowatt has been developed and produced in HEPTI to date, power plant working system on basis of PEM fuel cell stack (system of fuel and oxidant supply, thermal control system, hydrogen safety system, control system).

Besides motor transport power plant on basis of PEM fuel cell stack also can be used for cathode protection of pipelines, decentralized power supply of buildings, constructions, and various control equipment systems. Additionally the works on creating of mini and micro fuel cells with direct oxidation of alcohol for supplying portable devices (computers like "Notebook", cellular phone and etc) is being done. For example, the prototype of methanol-air PEM fuel cell, power about 3 kilowatt with convection delivery of air, has been developed in HEPTI RRC "Kurchatov Institute".

High-performance electrocatalysts on carbon carrier with platinum specific surface more than 100 m²/g, original technology of membrane-electrode assembly production, supporting optimized structure of electrocatalytic layer with the catalyst loading 0.1-0.4 mg/cm² has been developed for applying in power plant with PEM in HEPTI. Multicomponent catalyst technology is

worked over, including catalysts on basis of palladium, stable to carbon oxide and other gas additive, both in hydrogen contains fuel mixture (for example, products of organic fuel conversion) and in the air. Gas diffusion layers with high porosity, conductivity and mechanical strength were developed. Metal and graphite bipolar plates are produced and tested. Method of gas-dynamic study with use of electrodiffusion diagnostics in bipolar plate channels with the purpose of flows optimization has been developed. Processes of mathematical modeling in fuel cell were done. All of this allows to achieve current density about 1 A/cm² under voltage 0.7 V. Besides the new membranes with better characteristics for PEM fuel cells is being developed together with Keldish Centre.

Analysis of using in fuel cell stacks gas mixtures with various concentration of hydrogen as fuel was realized in the framework of program of Moscow Committee on Science and Techniques. Mathematical simulation allowed calculating parameters of stack with adjusted power under using diluent's in hydrogen (for example, when natural gas products conversion, gasoline, methanol and alcohol applying as a fuel) was developed. Simulator accounts demonstrate that, the lower initial hydrogen concentration in worker blend is, the more blending consumption should be to support effective fuel cell work conditions. The result of the decreasing of the initial hydrogen's concentration from 75 to 40 vol. % is the increasing of the number of cells approximately in 2 times more for fuel cells stacks of the same power. In this way the hydrogen exit loss increase in 3-4 times more, supplying hydrogen contains fuel power inputs increase too. Thus, the accounts show that using of fuels with high hydrogen concentration is advisable, and using CO₂ removal system is perspective.

It might be marked, that automobile power plants where hydrogen can be held or it can be produced on the board from hydrocarbon fuel by the conversion method. For the last case HEPTI RRC "Kurchatov Institute" engineered plasma catalysis method that is recommended to use for the reducing specific power inputs and for the

increasing specific productivity. Plasma's catalysis gives the opportunity to eliminate traditional catalysts in the processes of the conversion of the gas and liquid hydrocarbon fuel (natural gas, gasoline, methanol and alcohol etc) into the "syn-gas" (hydrogen and carbon dioxide mixture). In present compact demonstrational "plasma converters" is engineered and produced in HEPTI for realization of such processes in the microwave discharge were developed and made with the purpose of syn-gas obtaining from any hydrocarbon raw materials. Use of microwave discharges for creation of plasma has a number of advantages, such as: absence of electrodes provides necessary durability of the converter; magnetrons, used for generation of microwave radiation, together with systems of power supply are compact and well mastered by the industry as the basic part of microwave ovens. Operating performances of the plasma converter the following: frequency of microwave radiation - 2.45 GHz, capacity of the plasma converter - 3 kW, productivity - 20 m³/hour of syn-gas. Such devices can serve as a prototype of the onboard plasma converter of liquid fuel for the hydrogen car, and also the prototype for independent power supply system. For this purpose it is necessary to add to

converter the shift reactor, which is carrying out steam conversion of carbon oxide to hydrogen, and the system of thin purification of hydrogen from impurity for its subsequent use in fuel cell with the purpose of electricity production. Now experimental works are underway on plasma converter characteristics and catalytic shift reactor coordination, and as the most compact membranous method hydrogen treatment from touch is investigate in HEPTI.

Conclusions

Thus, it is possible to conclude, that within the framework of program of Moscow Committee on Science and Techniques key systems for creation of a hydrogen infrastructure in Moscow and Moscow region. Provided works on creation of PEM fuel cells based power plants, first of all, used hydrogen and air, respect to the most modern world tendency of environmentally-friendly technologies development.

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