# HIGH POROSITY ACTIVE ANTHRACITE AS MATERIAL FOR FUEL CELL

**Tkachenko T.V.,* Zubenko S.A., Polunkin E.V., Golovko L.V., Povazhniy V.A.**

Institute of Bioorganic Chemistry and Petrochemistry
Kharkivs'ke shose, 50, Kiyv, 02160 Ukraine
**Fax: 38(044)559-66-18 E-mail: tkachenko_tatyan@mail.ru*

**Introduction**

Carbon materials are used widely in recent time as adsorbents, catalysts and supporters because expansion of traditional and appearance of new spheres of their application [1, 2]. The efficiency of their application as catalyst supporters is caused by ability to essential increasing a working metal surface and simultaneously reducing of its mass. It is very important in case of use the noble metals as catalytic systems [2]. Therefore, the choice of optimal carbon material with highly developed surface as supporter for fuel cell electrocatalysts is a very actual problem today.

The aim of this work is a study the effect of supporter's nature to the structure, properties and catalytic activity of metal/C composites.

**Results and discussion**

The active anthracite was produced from the natural Donetsk anthracite (Ukraine) by steam activation in the furnace with boiling bed at temperature 800-900 $^{o}$C was used for obtaining metal/C catalysts [3]. The sample with next structure-adsorptive properties was chosen for research: apparent density 0.24 $cm^3/g$; specific surface area 900 $m^2/g$; limiting adsorption capacity on benzene vapor 0.55 $cm^3/g$; total pore volume by nitrogen 0.55 $cm^3/g$; micropore volume 0.23 $cm^3/g$. Catalysts were obtained by impregnation of palladium, nickel, silver and copper precursor's solution of different concentrations. Metal/C nanostructure catalysts were obtained by variation of composition and initial solution nature, temperature and restorative types.

The nitrogen adsorption-desorption isotherms were gaged with use of Sorptometer "KELVIN-1042" (Costech Microanalytical). The limiting adsorption capacity on benzene vapor and water was measured by use of desiccator method.

Efficiency of modifying highporous active anthracite was tested in fuel cell with membrane Nafion-117 at temperature about 20 $^{o}$C and atmospheric pressure. The volt-ampere characteristics of fuel cell were studied. The catalyst put in corresponding cells in powder form with particle size in range 0.2-0.6 mm. For estimation of relative efficiency value the tested catalysts were put in anode and cathode zone by turn.

Current density was 1.2 mkA/см$^2$ in case that supporter without catalysts was tested in the anode zone fuel cell. Supported catalysts putting in the anode zone fuel cell allow only got current density from 3.6 mkA/см$^2$ for 2.5 % (by weight) of nickel to 70 mkA/см$^2$ for 5 % of palladium. Subsequently, catalyst with 2.5 % of palladium as one of the most effective was putted in the anode zone fuel cell. The same catalysts were changed by turns in the cathode zone. Obtained experimental dependences were shown identical series of catalyst efficiency but the current densities values were 1.5 mA/см$^2$ for 2.5 % of nickel and 3 mA/см$^2$ for 5 % of palladium. The last value of current density is comparable with modern literature data [4]. It is confirm an efficiency of our produced electrocatalysts for fuel cell applications and promising route of their future optimization.

**References**

1. Liholobov V.A. Catalytic synthesis of carbonmaterials and their application in catalysis. SRJ 1997; (5): 35-42 (in Russian).

2. Samonin V.V., Kudenko V.V., Chentsov M.S. Development of new metal carbon and metal inorganic nanomaterials with high sorbs capacity for the hydrogen accumulating and storage. Alternative Energy and Ecology. 2005; (1): 16 (in Russian).

3. Golovko L.V., Povazhny V.A. Resaerch of adsorption characteristics of the characteristic active anthracite. Chem. Technol. 1989; (3): 27-29 (in Russian).

4. Tsivadze A.Yu., Tarasevich M.R., Andreev V.N. etc. Platinum-free catalysts for bioethanol electrooxidation and fuel cells based on these catalysts. Alternative Energy and Ecology. 2007; 48 (4): 57-62 (in Russian).