

Effect of conditions of modifying with Pd-Me compositions on electrocatalytic activity of Ni-Zn surface skeletal catalysts in electroreduction of hydrogen peroxide

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The technology of effective Ni-electrodes and electrocatalysts for different processes includes their covering by a layer of electronegative metal like Zn using galvanic method and exposing at 350-700°C in inert gas to form on the Ni-surface alloy foil. Then alloying metal is chemically removed from the surface film yielding thin porous layer with high surface area [1]. The electrochemical way for preparation of high developed metal surface with simultaneous introduction of microamounts of any metal and oxide gives the possibility to vary metal oxide and element composition of the catalysts. These catalysts are effective for catalytic purification of technological and waste engine gases, electrocatalytic oxidation of hydrazin or hydrogen in fuel cell, electrocatalytic reduction of H<sub>2</sub>O<sub>2</sub> bipolar regime [2].

The object of present study is to reveal an influence of modifying Ni-Zn catalysts by Pd-Ag compositions on electrocatalytic characteristics of the catalysts in hydrogen peroxide electroreduction. Recently we have shown [1] that one of the reasons for low stability of the catalysts is dissolution of promoters associated with formation of high charged ionic species upon electrode performance in hydrogen peroxide. Hence to stabilize a cathode one should develop corrosion proof compositions. Modifying electrode with Pd-Ag composition was carried out in ammonia trilon B electrolyte at pH 9-9,5 and cathod current density 0,2-0,5 A/dm<sup>2</sup> in three ways. I - Ni-Zn surface skeletal catalysts (SSC) was treated with Pd-Ag electrolyte in current-free conditions when precipitation of Pd-Ag alloys is conditioned by adsorption and electrochemical substitution. II - Pd-Ag alloy was supported on Ni foil electrochemically prior to zinc supporting. The subsequent thermal treatment of Ni-Pd-Ag-Zn alloy leads to implantation of promoters throughout the bulk of thermodiffusion alloy. III - Electroprecipitation of Pd-Ag compositions on Ni-Zn SSC at different current density and electrolysis time (table).

The electrocatalytic activity was assessed using current "i" at polarization η=50 mV upon electroreduction of H<sub>2</sub>O<sub>2</sub> (0,5 N) in 2N KOH. The surface area was determined from hydrogen region of charge curves. It goes from the table that this method of fabrication of Ni electrode allow to achieve 0,7-1,3·10<sup>4</sup> fold enhancement of surface area.

It was found that first method (I) does not lead to enhancement of activity (N1). The second method (II) also does not improve electrocatalytic characteristics (N3). Activity of samples prepared through supporting Pd-Ag composition on skeletal layer (III) depends on both current density, precipitation time and surface state of skeletal layer.

The best results have been obtained in the case when Pd-Ag composition was supported on fresh-prepared skeletal surface. In this situation on reduction of H<sub>2</sub>O<sub>2</sub> (0,5N) current density reaches 1485 mA/cm<sup>2</sup> at η=50 mV.

2. 9<sup>th</sup> Internat. Metallurgy and Materials Congress. 11-15 June 1997, p.225-227.

Table.

Electrocatalytic characteristics of Ni-Zn SSC modified with Pd-Ag composition depending on way of modification

N	Method of Pd-Ag supporting			i, mA/cm <sup>2</sup>	τ, min	Surface area and method of supporting	i <sub>0</sub> , mA/cm <sup>2</sup>
	I	II	III				
1	-	5	I	60	11348		
2	1	5	II	100	13412		
3	0,7	5	III	220	7355		
4	5	1	III*	1000	8656		
5	5	3	III*	1300	7890		
6	5	6	III*	300	7535		
7	5	1	III**	1420	8850		
8	5	3	III**	1485	8540		

I - on skeletal layer without current

II - on Ni foil under Zn layer

III - on skeletal layer

\* - on dried skeletal layer

\*\* - on fresh prepared skeletal layer