HYDROGEN ELECTROSYNTHESIS WITH ANODE PROCESS DEPOLARIZATION BY ALUMINUM ALLOYS

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One direction of research into new methods of electrochemical hydrogen synthesis is the aluminium-hydrogen cycle operating in the USA, Canada, Russia, which is based on the anodic dissolution of widely available aluminum alloys in alkaline and alkaline chloride solutions.

Hydrogen electrosynthesis method with anode process depolarization with aluminum alloys is proposed. The depolarization effect is based on aluminum alloy dissolution on anode instead of oxygen discharge. Aluminum dissolution parameters are influenced by a number of factors: the concentration of the electrolyte components, the composition of the aluminum alloy, the current density, the temperature, the surface structure of the alloy.

The influence of the aluminum alloy composition (table) on the process of its anodic dissolution in 1 M NaOH with the addition of 1 % NaCl solution as an activator was investigated within a temperature range of 25–30 °C. Polarization characteristics in the electrode materials research were obtained with using of the PI-50.1 potentiostat with "TeleMax" analog-to-digital converter data-transferring to a computer. Electrolysis in galvanostatic mode was carried out using a stabilized direct current source Power Supply 15V-15A.

Table. Aluminum alloy composition

Alloy type	Chemical composition, %						
	Al	Mn	Mg	Cu	Fe	Zn	Si
AMts	Main component	1–1,6	0,2	0,1	0,7	0,1	0,5
AMg	Main component	0,2	0,7–1,6	0,1	0,1	–	0,1
AK8	Main component	0,2–0,6	0,2–0,55	1,5	1	–	6–8

According to the analysis of the anodic polarization characteristics obtained with using electrodes made from the investigated alloys, it was established that the highest dissolution rates of alloys are occurred at potentials E = -0,5 ÷ -0,3 V after which the limit current density connected with the formation of oxide-chloride compounds due to chlorine-ions adsorption is appeared. The anode dissolution rate of the AMg alloy electrode is maximal, because of the magnesium impurity complete dissolution and diffusion into the solution under the anodic polarization conditions. Manganese and silicon impurities in the AMts and AK8 alloys compositions form insoluble oxides compounds on the anodes surface, which prevents their dissolution.

Electrolysis in galvanostatic mode was carried out using an anode made from an aluminum alloy AMg. Hydrogen electrosynthesis with a gradual change of the operating current density from 3 to 1 A/dm^2 can be implemented continuously for 8–10 hours. The voltage on the cell is 0,7–1 V.

Voltage reduction in the electrolyzer for 1,0–1,5 V in comparison with alkaline electrolysis, which leads to electricity saving up to 50 %, can be reached by aluminum alloys depolarization of anode process. This process is safer because of absence of oxygen discharge.