To validate the suggested dissolution mechanism, the WC-Co (6%) bars were anodically dissolved at the different values of potential corresponding to the zones 1 and 2 in the polarization curve and the dissolution duration. Table 1 summarizes the results of analyzing the produced solutions. As the potential rises, the dissolution rate of the cobalt and tungsten and the weight proportion of Co and W in-the total weight fraction of the dissolved metals increase. At potential more positive than 0.70 V, the evolution of gas at the anode surface is observed. The results of its chromatographic analysis identified it as carbon dioxide.

According to the data listed in Table 1, the weight fraction of tungsten in the total weight of the dissolved metals is 11.3 to 14.2%, which corresponds to the data on its dissolution in cobalt. It should also be noted that the main part of the anode current is spent for the cobalt dissolution. That is why the polarization curves for the WC-Co (6%) arid cobalt electrodes are much alike in shape and close in value (Fig. 1; curves 1, 3).

Table 1 – Dissolution rate of cobalt and tungsten as a function of the potential of the WC-Co (6%) electrode for the 1.25 M H3PO4 solution at a temperature of 18 °C

Electrode potential, V	Experiment duration, h	Dissolution rate, g/(m^2 h)		Tungsten weight fraction, wt %
		Cobalt	Tungsten	
-0,33	30	0,095	*)	
-0,25	20	3,419	*)	
-0,20	20	10,652	1,391	11,3
-0,15	20	18,006	2,876	12,6
-0,10	10	25,556	4,571	14,1
-0,05	10	28,373	5,319	14,2
0,80	5	16,625	48,315	87,9

The simultaneous dissolution of the cobalt and tungsten is noticeably accelerated as the potential increases. When the potential reaches a value of -0.02 V, the electric current density sharply decreases to a value equal to 15 to 20% of its maximum value. According to the data of X-ray phase analysis, the passivated film consists mainly of tungsten oxide WO_3 and cobalt phosphate.

When oxygen is absent in the solution, the cathode current corresponds to the reduction of hydrogen ions (Fig. 1, curve 4). The extrapolation of the corresponding polarization curve to the potential axis (Ecor) corresponds to electric currents of the same order as those measured for cobalt dissolution without polarization. It can also be assumed that the rate of dissolution of the Co-W phase from the hard alloys depends on the thickness of the sample, the cobalt weight fraction in the alloy, and the sizes of cobalt and tungsten carbide grains. Indeed, the replacement of WC-Co (6%) alloy particles of size 1.0 to 2.0μm by WC-Co (5%) particles of size 5 to 1.0μm, leads to 1.1 to 1.3 times higher dissolution rates.

The selective dissolution of the WC-Co phase can be used for the recycling of hard alloy scrap. In this case, it is desirable that the separation of cobalt from carbide be accomplished at as low power consumption as possible. After the WC-Co phase is dissolved, the residual tungsten carbide after grinding can be again suitable for the production of hard-alloy tools.

The potentiostatic mode of anodic dissolution of tungsten carbide-cobalt alloys in phosphoric acid solutions, which makes it possible to selectively dissolve tungsten and cobalt and separate the solid tungsten carbide phase, is experimentally validated and practically implemented.

The curves of the rate of dissolution of cobalt and tungsten in the WC-Co (6%) alloy versus the electrode potential and dissolution duration are determined.

ПОРІВНЯННЯ АЛГОРИТМІВ ФАКТОРИЗАЦІЇ МАТРИЦЬ ДЛЯ ДЕТЕКТУВАННЯ М'ЯЗОВИХ СИНЕРГІЙ

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Досліджуються м'язові синергії та порівнюються два методи факторизації матриць: метод головних компонент та невід'ємної факторизації матриць, які використовуються для їх знаходження з набору електроміограм м'язів, отриманих в результаті експерименту з симетричної активації м'язів рук. Результати роботи дають обґрунтування та пояснення переваги методу невід'ємної факторизації матриць.

Ключові слова: електроміографія, синергії.

COMPARISON OF MATRIX FACTORIZATION ALGORITHMS FOR DETECTING MUSCLE SYNERGIES

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In the article, muscle synergies are investigated and two matrix factorization methods are compared: principal component analysis and non-negative matrix factorization. They were applied to find muscle synergies from the set of electromyograms of the muscles, obtained as a result of the experiment on symmetric arm muscles activation. The results of the work provide a rationale and an explanation of the advantages of non-negative matrix factorization method.

Keywords: electromyography, synergy.