Induced co-deposition of tungsten using iron to form metallic alloys

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Abstract

This research investigates tungsten alloys co-deposited with iron. The influence of the electric current density, iron concentration in the electrolytic bath and temperature on the electrodeposition efficiency was analyzed. The obtained alloys were characterized using a scanning electron microscope (SEM), X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR). The greatest obtained electrodeposition efficiency was approximately 50%.

Key words: electrodeposition, alloys, corrosion.

Introduction

Corrosion generates various industrial problems. In order to reduce it, an efficient and inexpensive way is to use electrodeposited protective coatings. Tungsten alloys can be used as protective coatings because they have very good features, including great corrosion resistance. However, the electrodeposition of tungsten in its pure state starting from its aqueous solution is not feasible[1]. On the other hand, it is possible to electrodeposite it as long as the tungsten is in solution with iron group metals[2]. Therefore, the tungsten electrodeposition in the presence of iron in order to form corrosion resistant alloys was evaluated. The best alloys were characterized using SEM, XRD and FTIR.

Results and Discussion

The iron concentration (C_{Fe}) was the parameter that presented the greatest statistical influence on the efficiency, with a confidence level of 95%. The statistical model that correlates the electrodeposition efficiency (ε), presented in the Chart 1, to this parameter is given by Equation 1:

$$\varepsilon = 281 \cdot C_{Fe} + 13{,}54 \qquad (1)$$

Chart 1. Electrodeposition efficiences

Exp.	C_{Fe} (mol/L)	I (mA/cm^2)	T (°C)	ε (%)
1	0,01	10	25	9,65
2	0,1	10	25	50,05
3	0,01	50	25	7,99
4	0,1	50	25	37,5
5	0,01	10	60	11,91
6	0,1	10	60	18,19
7	0,01	50	60	10,68
8	0,1	50	60	35,69
9	0,055	30	42,5	40,02
10	0,055	30	42,5	39,95
11	0,055	30	42,5	35,29

The scanning electron microscopy results indicate the presence of nodules and microcracks in the alloys, as shown in Image 1.

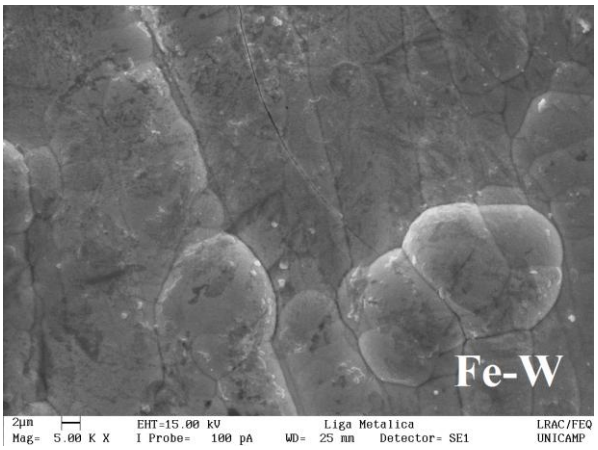

Image 1. Fe-W alloy micrograph

The XRD and FTIR analysis revealed that the obtained alloys are amorphous and have a high purity.

Conclusions

The greatest electrodeposition efficiences were obtained for higher iron concentrations at 25°C. The characterization results indicate that the obtained alloys present interesting features, such as low crystallinity, high purity and adherence and thus they may be corrosion resistant.

Acknowledgement

The authors thank FAPESP and CNPq for the financial support.

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