

ELECTRODEPOSITION OF A NANO-STRUCTURED Ni-W ALLOY AND CHARACTERIZATION OF ELECTROCATALYTIC PROPERTIES

Ma Miaomiao, V. S. Donepudi and Jai Prakash
Department of Chemical and Environmental Engineering,
Illinois Institute of Technology,
Chicago, IL, 60616, USA.

and

G. Sandi, Gary P. Wiederrecht and G. Wurtz, Argonne National Laboratory,
Chemistry Division, Argonne, IL,
60439, USA.

Nickel-tungsten alloys are hard and are known to have excellent corrosion resistance and magnetic properties. The electrodeposition of these alloys from citrate solutions dates back to 1948 (1). Subsequently, these alloys were electrodeposited from pyrophosphate solutions also (2). Very recently, nano-structured nickel-tungsten alloys containing 17-22% tungsten alloys have been electrodeposited from pH 8.5 citrate solutions having sodium bromide as an addition agent (3). The crystal structure and nano-structure of these alloy coatings as well as their magnetic properties were determined using x-ray diffraction, SEM and coercivity measurements (3).

Further studies were continued in our laboratories with an objective of characterizing the electrocatalytic properties of electrodeposited nano-structured nickel-tungsten alloys. Initially, the nickel-tungsten alloys having 20% tungsten were electrodeposited on copper substrates from pH 8.5 citrate-bromide electrolytes using the same plating conditions as under reference (3). The phenomenon of polarization and depolarization was studied from the current-potential relationships. Figure 1 shows that addition of tungstate to the plating causes considerable depolarization thereby facilitating alloy deposition. Agglomerates of nickel-tungsten alloy can be seen in the Atomic Force Microscopic (AFM) images shown in Figure 2. Subsequently, the kinetics of

oxygen reduction reaction were compared on a graphite rotating disk electrode without and with nano-structured nickel-tungsten alloy. The results of these studies will be presented.

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References

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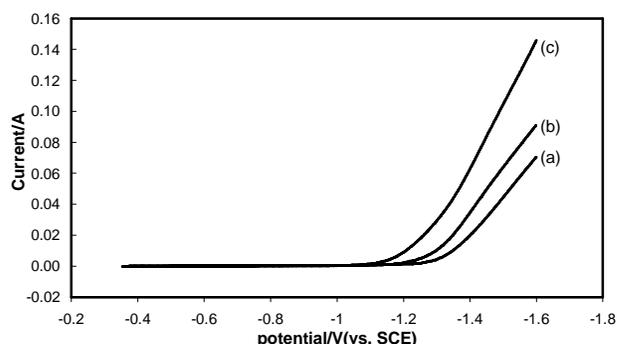


Figure 1. Deposition potentials of tungsten (a) -1.33V, nickel (b) -1.28V, and nickel-tungsten alloy (c) -1.24V. Bath Composition: $\text{Na}_3\text{C}_6\text{H}_5\text{O}_7 \cdot 2\text{H}_2\text{O}$, 0.4M; NH_4Cl , 0.5M; NaBr , 0.15M; (a) + $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$, 0.14M; (b) + $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$, 0.06M; (c) + $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$, 0.14M and $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$, 0.06M. Unstirred solutions; Bath temperature: 60°C.

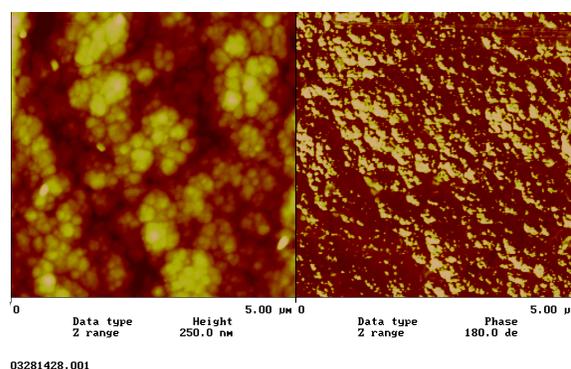


Figure 2. AFM Image of Nickel-Tungsten Alloy Electrodeposited from Citrate Bath at 100 mA/cm². Bath composition and operating conditions as under Figure 1.