

## The Electrochemical Behavior of Ni-base Metallic Glasses Containing Cr in H<sub>2</sub>SO<sub>4</sub> Solutions

Sanaa. T. Arab<sup>†</sup>, Khadijah. M. Emran<sup>\*</sup>, and Hamad A. Al-Turaif<sup>‡</sup>

*Department of Chemistry, Girls' College of Education, Taibah University Al-Madinah Al-Monawarah, Kingdom Saudi Arabia*

<sup>†</sup>*Department of Chemistry, Girls' College of Education, King Abdulaziz University, P.O.(2321), Jeddah 21451, Kingdom Saudi Arabia*

<sup>‡</sup>*Department of Chemical and Materials Engineering, King Abdulaziz University Jeddah, Kingdom Saudi Arabia*

(Received December 5, 2008)

### ABSTRACT

*In order to develop alloy resistance in aggressive sulphat ion, the corrosion behavior of metallic glasses Ni<sub>92.3</sub>Si<sub>4.5</sub>B<sub>32</sub>, Ni<sub>82.3</sub>Cr<sub>7</sub>Fe<sub>3</sub>Si<sub>4.5</sub>B<sub>3.2</sub> and Ni<sub>75.5</sub>Cr<sub>13</sub>Fe<sub>4.2</sub>Si<sub>4.5</sub>B<sub>2.8</sub> (at %) at different concentrations of H<sub>2</sub>SO<sub>4</sub> solutions was examined by electrochemical methods and Scanning Electron Microscope (SEM) and X-ray Photoelectron Microscopy (XPS) analyses. The corrosion kinetics and passivation behavior was studied. A direct proportion was observed between the corrosion rate and acid concentration in the case of Ni<sub>92.3</sub>Si<sub>4.5</sub>B<sub>32</sub> and Ni<sub>75.5</sub>Cr<sub>13</sub>Fe<sub>4.2</sub>Si<sub>4.5</sub>B<sub>2.8</sub> alloys. Critical concentration was observed in the case of Ni<sub>82.3</sub>Cr<sub>7</sub>Fe<sub>3</sub>Si<sub>4.5</sub>B<sub>3.2</sub> alloy. The influence of the alloying element is reflected in the increasing resistance of the protective film. XPS analysis confirms that the protection film on the Ni<sub>92.3</sub>Si<sub>4.5</sub>B<sub>32</sub> alloy was NiS which is less protective than that formed on Cr containing alloys. The corrosion rate of Ni<sub>82.3</sub>Cr<sub>7</sub>Fe<sub>3</sub>Si<sub>4.5</sub>B<sub>3.2</sub> and Ni<sub>75.5</sub>Cr<sub>13</sub>Fe<sub>4.2</sub>Si<sub>4.5</sub>B<sub>2.8</sub> Alloys containing 7% and 13% Cr are 7.90-26.1×10<sup>-3</sup> mm/y which is lower about 43-54 times of the alloy Ni<sub>92.3</sub>Si<sub>4.5</sub>B<sub>32</sub> (free of Cr). The high resistance of Ni<sub>75.5</sub>Cr<sub>13</sub>Fe<sub>4.2</sub>Si<sub>4.5</sub>B<sub>2.8</sub> alloy at the very aggressive media may due to thicker passive film of Cr<sub>2</sub>O<sub>3</sub> which hydrated to hydrated chromium oxyhydroxide.*

**Keywords:** Nickel base metallic glasses, Passivity, Role of chromium, Spontaneous passivation, Polarization, EIS, XPS, SEM