Effect of Yttrium Addition on Corrosion Resistance of Zr-based Bulk Metallic Glasses in NaCl Solution

Liusi Yu¹, Junlei Tang^{1,*}, Jichao Qiao², Hu Wang³, Yingying Wang¹, Mihai Apreutesei⁴,
Mohammad Chamas¹, Ming Duan¹

¹ School of Chemistry and Chemical Engineering, Southwest Petroleum University, Chengdu 610500, P.R. China

² School of Mechanics, Civil Engineering and Architecture, Northwestern Polytechnical University, Xi'an 710072, P.R. China

³ School of Material Science and Engineering, Southwest Petroleum University, Chengdu 610500, P.R. China

⁴ Université de Lyon, Institut des Nanotechnologies de Lyon INL-UMR5270, CNRS, Ecole Centrale de Lyon, Ecully F-69134, France

*E-mail: tangjunlei@126.com

doi: 10.20964/2017.07.47

Received: 11 April 2017 / Accepted: 2 May 2017 / Published: 12 June 2017

This study investigated the effect of yttrium addition on the electrochemical properties of $(\text{Zr}_{58}\text{Nb}_3\text{Cu}_{16}\text{Ni}_{13}\text{Al}_{10})_{100-x}\text{Y}_x$ ($x = 0, 0.5, 2.5$ at.%) bulk metallic glasses in 3.5 wt.% NaCl solution. Electrochemical measurements, scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) were employed. Zr-based bulk metallic glasses exhibited good corrosion resistance. It was ascribed to the formation of a protective passive film which was composed of ZrO_2 , Al_2O_3 and a few oxides of other alloying elements, i.e. Y_2O_3 . However, the breakdown potential decreased due to the addition of yttrium. Electrochemical impedance spectroscopy (EIS) suggested that yttrium addition could decrease the charge transfer resistance. That is, the addition of yttrium was harmful to the corrosion resistance of this Zr-based bulk metallic glass in 3.5 wt.% NaCl solution. It was attributed to the precipitation of Cu-Y richly quasi-crystal phase owing to yttrium addition, which caused inhomogeneous distribution of copper and yttrium in microstructure.

Keywords: Zr-based bulk metallic glasses; Pitting corrosion resistance; Yttrium; Electrochemical measurements; XPS

[FULL TEXT](#)

© 2017 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).