|  |  |  |
| --- | --- | --- |
| agh_znk_wbr_rgb_150ppi | FACULTY OF FOUNDRY ENGINEERINGINTERNATIONAL WORKSHOP***90 Years of Educating Foundry Engineers by the******AGH University of Science and Technology in Krakow***connected with XXXVI SCIENTIFIC CONFERENCE FOUNDRYMAN' DAY 2012 Krakow, 22 – 23 Nov. 2012 |  |
|  |  |  |

COROSSION BEHAVIOUR OF TITANIUM ALLOYS IN PHYSIOLOGICAL SOLUTIONS

Joanna Loch1, Halina Krawiec2

1, 2 AGH University of Science and Technology. Faculty of Foundry Engineering. Reymonta 23, 30-059 Krakow, Poland

1asialoch@gmail.com ; 2krawiec@agh.edu.pl

**Keywords**: titanium alloy, corrosion, physiological solutions

**Abstract**

Titanium alloys are widely used in industrial applications such as in the aerospace, chemical and medical sectors. TiAl6V4 has a heterogeneous microstructure composed of two metallic phases ( and  with a content of  between 5 and 20%). The phase has a hexagonal close packed structure whereas the phase has a body centered cubic structure. In addition, intermetallics (such as Ti3Al, TiAl and TiAl3) can be formed during heat treatments. These treatments are performed to increase the yield strength of the alloy by structural hardening (up to values around 1000 MPa).

 Passivity of TiAl6V4 has been extensively studied at the macroscale using XPS, Auger and electrochemical impedance spectroscopy [1-4]. It has been shown that the passive film was predominately titanium(IV) oxide TiO2. Its quantity was found to increase with applied potential. A small amount of suboxides TiO and Ti2O3 was detected at the inner interface. Aluminium oxide (Al2O3) was present throughout the passive film with enrichment at the outer passive film/solution interface. Vanadium oxides (V2O3 and V2O5) could be present in the passive film in extremely small quantity. Current-time transient studies have shown that the passive film shows good ability to be formed on TiAl6V4 in NaCl solutions [5]. After long-term ageing in NaCl-based media, the passive film formed on TiAl6V4 shows again a good resistance against corrosion [6-8]. However, it has also been demonstrated that certain ions from the solution can alter the passive properties of the alloy, such as calcium and phosphorus ions [9-11].

The effects of alloying elements on the cytotoxic response of titanium alloys have recently been studied [12]. As a result, Nb, Ta and Zr have been selected as the safest alloying elements to titanium. In addition to these elements, Mo and Sn have been selected as safer elements for living bodies. Consequently, new titanium alloys containing non-toxic elements and having extremely a low elastic modulus (much lower than those of pure Ti and Ti–6Al–4V alloy) have been developed [13, 14]. The corrosion behaviour of these new titanium alloys is not well understood (especially the role of the microstructure). This is the case of Ti12Mo5Zr ( phase).

 There is a lack of knowledge concerning the role of alloying elements, plastic deformation and the microstructure in the micro-electrochemical behaviour and the pitting corrosion susceptibility of TiAl6V4 and TiMo12Zr5 alloys in physiological solutions. In the present paper, electrochemical measurements (polarization curves and impedance diagrams) and corrosion tests (by means of potentiostatic pulse testing) were performed to determine the role of alloying elements on the passivity properties of TiAl6V4 and TiMo12Zr5 alloys and on pit initiation and propagation in Ringer and Hank solutions.

**Acknowledgements**

This work was supported by the Polish National Science Center (under the project HARMONIA no DEC - 2012/04/M/ST8/00681).

**References**

[1] J. Lausmaa, J. Electron Spectrosc. Relat. Phenom. 81 (1996) 43-361.

[2] V. Zwilling, E. Darque-Ceretti, A. Boutry-Forveille, D. David, M.Y. Perrin, M. Aucouturier, Surf. Interf. Anal. 27 (1999) 629-637.

[3] W.Y. Guo, J. Sun, J.S. Wu, Mater. Chem. Phys. 113 (2009) 816-820.

[4] I. Milosev, M. Metikos-Hukovic, H.H. Strehblow, Biomaterials 21 (2000) 2103-2113.

[5] S. Kumar, T.S.N. Sankara Narayanan, J. Alloy Compd. 479 (2009) 699-703.

[6] V.A. Alves, R.Q. Reis, I.C.B. Santos, D.G. Souza, T. de F. Gonçalves, M.A. Pereira-da-Silva, A. Rossi, L.A. da Silva, Corros. Sci., 51 (2009) 2473-2482.

[7] A.M. Fekry, M.A. Ameer, Int. J. Electrochem. Sci. 6 (2011) 1342-1354.

[8] S.L. Assis, I. Costa, Mater. Corros. 58 (2007) 329-333.

[9] A. Hodgson, Y. Mueller, D. Forster, S. Virtanen, Electrochim. Acta 47 (2002) 1913-1923.

[10] R. Narayanan, S.K. Seshadri, Corros. Sci. 50 (2008) 1521-1529.

[11] E. Alkhateeb, S. Virtanen, J. Biomed. Mater. Res. 75A (2005) 934-940.

[12] A. Cremasco, A.D. Messias, A.R. Esposito, E.A. de Rezende Duek and R. Caram, Materials Science and Engineering: C, 31, p. 833 (2011).

[13] C. Zhao, X. Zhang and P. Cao, Journal of Alloys and Compounds, 509, p. 8235 (2011).

[14] L. Slokar, T. Matković, P. Matković, Materials & Design, 33, p. 26 (2012).