Microstructure dependent corrosion of newly developed Mg-Zn-Y-Al alloys containing LPSO phases

Anna Dobkowska, Diana Martinez, Aleksandra Zielińska, Wojciech Święszkowski

Faculty of Materials Science and Engineering, Warsaw University of Technology, Woloska 141, 02-507 Warsaw, Poland
E-mail: anna.dobkowska@pw.edu.pl

Magnesium alloys, because of their low density and high specific strength, are attractive structural materials. Nevertheless, their wide use in the industry is restricted due to insufficient corrosion resistance. Therefore, the Mg-based alloys containing long period stacking ordered (LPSO) structures have been recently developed [1–3]. The role of the LPSO phases in the micro-galvanic corrosion of Mg-Zn-Y-Al alloys was investigated, and their cathodic nature has been already proven [3]. Considering this matter, new solutions to reduce the microgalvanic effects are investigated. One of them is annealing as a result of which the homogenization of the microstructure can be achieved.

In this study, we have investigated the microstructural features which may significantly affect corrosion resistance of Mg-Zn-Y-Al alloys containing LPSO phases. To approach this, rapidly solidified and extruded Mg-Zn-Y-Al was investigated. Additionally, annealing under various conditions was performed. As a reference, conventionally extruded rod was taken.

The microstructural characterization was composed of electron back scattered diffraction, high resolution microstructure observations, as well as phase composition was analyzed. The corrosion resistance was analyzed based on the electrochemical measurements in 0.01 M NaCl at room temperature. This included open circuit potential evolution, electrochemical impedance spectroscopy and potentiodynamic polarization tests. Corrosion rate based on the hydrogen release was also measured. Corrosion damage was observed using field emission scanning electron microscopy, and surface development was tested using optical profilometry.

Our research clearly show that the corrosion resistance of the Mg-Zn-Y-Al alloys containing LPSO structures is microstructure dependent. The corrosion performance is not solely related to the ratio of anodic Mg matrix to cathodic LPSO phases, but also grain size and their crystallographic orientation play a significant role in the corrosion behavior of the investigated alloys.

1. M. Yamasaki, Z. Shi, A. Atrens, A. Furukawa, Y. Kawamura, Corrosion Science, **2022,** *200.*
2. D. Drozdenko, M. Yamasaki, K. Máthis, P. Dobroň, P. Lukáč, N. Kizu, S. ichi Inoue, Y. Kawamura, Materials Design, **2019**, *181,* 1–12.
3. D. Pałgan, A. Dobkowska, A. Zielińska, D. Drozdenko, K. Máthis, W. Święszkowski, Crystals, **2022**, *12*.

Akcnowledgements:
This work is financed by the National Centre for Research and Development in Poland within Visegrad Group (V4) Japan Joint Research Program—Advanced Materials under grant No. V4-JAPAN/2/15/MagMAX/2022.