Wikno, 16th–20th September 2025

MATHEMATICAL MODELING OF THE CORROSION PROCESS OF BIODEGRADABLE MAGNESIUM ALLOY IMPLANTS

Krzysztof Psiuk-Maksymowicz[1,2]

[1]Department of Systems Biology and Engineering, Faculty of Automatic Control, Electronics and Computer Science, Silesian University of Technology, ul. Akademicka 16, 44-100 Gliwice,
[2]Biotechnology Center, Silesian University of Technology, ul. Krzywoustego 8, 44-100 Gliwice
krzysztof.psiuk-maksymowicz@polsl.pl

ABSTRACT

Magnesium, due to its properties, is an excellent material for the production of biodegradable implants. These implants have a wide range of applications, including pediatric orthopedics. Thanks to mathematical modelling we are able to estimate the rate of implant degradation.

To model the corrosion process of implants made from magnesium alloys, different approaches were applied, including models based on the works of P. Bajger et al. [1] and N. Pohl et al. [2]. An analysis was conducted to determine which of the mathematical models best represents the nature of the process. A simulation of a PDE model with a moving interface was performed. The model evaluation was based on data from the literature (e.g., [3]) as well as experimental data.

ACKNOWLEDGMENTS

This research is supported by the Ministry of Education and Science (Poland) under statutory research funds of the Faculty of Automatic Control, Electronics And Computer Science of SUT.

REFERENCES

[1] P. Bajger, J.M.A. Ashbourn, V. Manhas, Y. Guyot, K. Lietaert, and L. Geris: *Mathematical modelling of the degradation behaviour of biodegradable metals*, Biomech Model Mechanobiol **16** (2017), 227–238.

[2] N. Pohl and D. Priebe and T. AlBaraghtheh and S. Schimek and D.C. F. Wieland and D. Krüger and S. Trostorff and R. Willumeit-Römer and R. Köhl and B. Zeller-Plumhoff: *Computational modelling of bone growth and mineralization surrounding biodegradable Mg-based and permanent Ti implants*, Computational and Structural Biotechnology Journal **27** (2025), 1394–1406.

[3] J.A. Sanz-Herrera, E. Reina-Romo, and A.R. Boccaccini: *In silico design of magnesium implants: Macroscopic modeling*, J Mech Behav Biomed Mater **79** (2018), 181–188.