Recent progress of self-healing coatings for magnesium alloys protection

N. A. Johari [a], J. Alias [a], A. Zanurin [a], N. S. Mohamed [a], N. A. Alang [b] & M. Z. M. Zain [c]

[a] Department of Mechanical Engineering, College of Engineering, Universiti Malaysia Pahang, Pahang, Gambang, Kuantan, 26300, Malaysia

[b] Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang, Pahang, Pekan, 26600, Malaysia

[c] Faculty of Mechanical Engineering Technology, Universiti Malaysia Perlis, Perlis, Arau, 02600, Malaysia

ABSTRACT

As the lightest structural metal and having a natural ionic presence with compatible biological systems, magnesium (Mg) has been emphasized in vehicle fuel economy for the automobile industry and is appropriate for biodegradable implants. However, the reactive nature of Mg makes it susceptible to corrosion. The electrochemical instability of Mg is due to long-term hydrogen gas evolution, microgalvanic reaction between the matrix and second phase, presence of impurities, and formation of non-protective corrosion product. Many studies have been done to protect Mg and its alloys from corrosion, and one way to prevent direct contact between magnesium substrate and corrosive medium is by applying a stable coating. Protective coating with self-healing properties has become an efficient technique to improve the corrosion resistance of Mg alloys. A self-healing coating can contain released ion exchange of corrosion inhibitors that could improve the coating stability significantly, while coating with embedded nanocontainers is able to autonomously self-heal via stimulus controlled-release upon crack and damages. In this review, recent studies on functional coating with self-healing ability including layered double hydroxides, cerium conversion coating, plasma electrolytic oxidation, graphene oxide coating, and smart self-healing coating are highlighted in the first section. The nanocontainers containing inhibitor coating and self-healing coating with superhydrophobic and biocompatibility function are reviewed afterward.

KEYWORDS

Magnesium; Self-healing coating; Nanocontainers; Superhydrophobic

ACKNOWLEDGEMENTS

The authors wish to acknowledge the financial support for research grants from the Ministry of Higher Education, Malaysia (FRGS/1/2019/TK05/UMP/02/5) and Universiti Malaysia Pahang (RDU1901128).