Magnesium Corrosion Research Special Issue

Geraint Williams (Swansea University) and Joey Kish (McMaster University)

Welcome to the second special issue of *CORROSION* devoted to current trends in magnesium corrosion research. This issue follows our original guest co-edited special issue published in May 2017, as well as two prior issues dedicated to magnesium and aluminum-magnesium alloys. The high susceptibility of magnesium and its alloys to corrosion is acknowledged to be the principal barrier to its widespread use as a structural metal. Hence, the subject of corrosion and protection of magnesium and its alloys remains one of the most highly cited fields in corrosion science and continues to stimulate significant interest and debate.

It is with great pleasure that we serve as guest co-editors for this issue, which presents invited original articles contributed by research groups from the United States, Canada, Germany, Australia, Malaysia, Sweden, and the United Kingdom. We are extremely grateful to the authors for finding the time to compile their manuscripts and to the reviewers for the rigor of their efforts, given the current unprecedented challenges of the COVID-19 pandemic. In addition, we would like to extend our gratitude to the editorial team of Prof. John Scully, Sammy Miles, and Marlene Walters for their invaluable advice and guidance.

For this latest special issue, we have sought to compile a selection of articles that cover a broad range of interests, which reflect the current cutting-edge of magnesium corrosion research. The first papers, by Glover and coauthors, seek to further the understanding of the phenomenon of cathodic activation of a corroding magnesium surface and demonstrate how a novel germanium alloying addition mitigates this effect, thus reducing the corrosion rate.

These are followed by a description of the development of a novel experimental method that allows dynamic pH control of an unbuffered test electrolyte, by Curioni, et al., along with preliminary findings on the pH-dependent electrochemical response of pure Mg. Several articles focus on the localized corrosion behavior of technologically important Mg alloys such as ZEK100 (Kousis, et al.) and Magnox Al-80 alloy (Clark, et al.), used in the automotive sector and first generation of U.K. nuclear reactions, respectively, and characterized using a scanning vibrating electrode technique. The same methodology, in combination with scanning electrochemical microscopy, is used by others (Thomas and coauthors) to investigate the time-dependent localized corrosion behavior of welded AM series alloy surfaces.

Another two papers focus on Mg corrosion inhibition, one using an empirical approach to investigate the effectiveness of lithium carbonate technology on AZ31 alloy (Kish and coauthors) and the other using density functional theory calculations to optimize the inhibitive properties of bipyridyl-based derivatives (Feiler, et al.). The importance of magnesium alloys as biodegradable materials for potential in vivo applications is addressed in contributions by Höhlinger, et al., and Chen and coauthors. The former describes a multifaceted approach to evaluate the corrosion rate of WE43 alloy in the presence of different types of surface coatings, while the latter quantifies the biocompatibility of a Mg surface immersed in simulated body fluid as a function of corrosion product film composition.

Finally, there are also valuable contributions which investigate the corrosion of binary Mg alloys prepared by high energy ball milling of nanocrystalline powders, by Gupta and coauthors, and the influence of carbon dioxide on the atmospheric corrosion of Mg-Al alloys in the presence of sodium chloride deposits, by Esmaily and coauthors.

We hope that you find the selection of articles both stimulating and informative.