

PLENARY SESSION

New concept for active control of Mg corrosion: from resorbable implants to boosting Mg-battery performance

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Magnesium and its alloys are among the lightest structural metallic materials and considered as promising materials for resorbable implants and energy storage. However, the high corrosion susceptibility significantly limits their application range. Recently different authors have demonstrated that noble impurities present in the Mg-based materials can play detrimental role for corrosion resistance making the degradation process hardly controllable. The results presented in this work contribute to understanding the role of iron impurities in the degradation process and suggest a way for linking the observed phenomena to the recent literature. The shown enhanced cathodic activity of dark areas especially at the corrosion front and the superfluous hydrogen are linked to an iron re-deposition mechanism [11]. The proposed mechanism is based on the results obtained from innovative characterization techniques using magnetic fields, diffraction experiments and transmission electron microscopy, which show the formation of iron rich zones, especially at the corrosion front offering "in statu nascendi" metallic Fe films acting as active cathodes for hydrogen reduction. The effect drastically accelerates corrosion of impurity containing Mg.

In the present work we assume that if Fe re-deposition is prevented, the area of cathodic sites can be drastically decreased and hence corrosion of Mg can be suppressed. In this proof of concept work we use strong Fe^{3+} complexing agents in order to remove dissolved iron cations from corrosion sites and prevent iron re-deposition. All used iron complexing agents efficiently lowered the corrosion rate of Mg. Direct correlation of complex stability with its inhibiting efficiency was established [2]. Applicability of this concept to control the degradation of Mg-based implants and to boost performance of primary Mg-air batteries is demonstrated.

References

1. D. Höche [et al.]. Phys. Chem. Chem. Phys. (2016) 18 : 1279.
2. S. V. Lamaka [et al.]. Electrochemistry Communications (2016) 62 : 5