Design strategy of multifunctional coatings upon Mg alloys

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Abstract Utilisation of light-weight magnesium (Mg) alloys as engineering materials is limited due to their high affinity for oxygen and water, and hence vulnerability to corrosion. There are two straightforward methodologies to suppress corrosion progress of Mg alloys. Addition of alloying elements, such as Al, Zn and even As, into the bulk Mg matrix which may lead to favorable microstructure, grain size or kinetic restriction to corrosion kinetics (with attendant changes in properties and cost). The other intensively exploited approach is applying stable and inert coatings onto the surface of Mg alloys as a barrier to provide protection functionality. Compared to alloying, surface properties will be altered rather than the fundamental properties of the bulk materials and desirable protection can be obtained by means of simply and efficient processing procedures. The most successful commercial coatings are chromate based, however, the extreme carcinogenicity to organisms and environments has led to a strict ban on the utilisation of chromate coatings globally. Therefore, there is an urgent need to develop alternative coatings to tackle the corrosion issue of Mg alloys as chromate did. Herein, we introduce some advanced techniques to develop smart coatings onto Mg alloys to perform multifunctioanl roles in addressing a number of challenges associated with commerical services of Mg alloys.

Keywords Magnesium alloys, multifunctional coatings, surface engineering, electrochemistry, biodegradation.