Simultaneous improvement of strength and corrosion resistance via the microstructure control of magnesium alloys

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Abstract Overcoming the inherent strength-corrosion resistance trade-off remains a significant challenge in magnesium (Mg) alloys. The strength of Mg alloys can be improved after artificial aging due to the formation of second phases, however, most of the second phases as the cathode would accelerate the galvanic corrosion of the surrounding Mg matrix. Recent studies by our group have found that the formation of Guinier-Preston (G.P.) zones rather than second phases during aging could enhance the strength of Mg alloys without damaging the corrosion resistance, and even simultaneously improve the corrosion resistance. Therefore, in this presentation, we would discuss in detail the effect of G.P. zones on the corrosion behaviour of Mg-Al-Ca dilute alloy. Based on the idea of forming G.P. zones to replace the second phases, we design and develop a novel low-cost, corrosion-resistant, and strong Mg-Al-Mn-Ca-Ce dilute alloy featured with yield strength (YS) of ~194 MPa, ultimate tensile strength (UTS) of ~265 MPa, and corrosion rate (CR) of ~2.2 mm y-1. The Ce micro-alloying can significantly improve the corrosion resistance by transforming the Al-Mn phase into Al-Mn-Ce phase, inhibiting detrimental effect of iron (Fe) impurities, and forming a protective Ce-containing surface film. The high strength stems from the combined effect of G.P. zones and fine-grained structure, and the formation of G.P. zones would not deteriorate the corrosion resistance. This presentation could shed light on the

design and fabrication of strong and corrosion-resistant dilute Mg alloys to be used in electronic products and automotive bodies.

Keywords: Magnesium alloy, G.P. Zones, Strength, Corrosion resistance, Microstructure regulation.