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# MICROSTRUCTURE ANALYSIS OF RARE EARTH-MAGNESIUM ALLOY REPAIRED USING HIGH POWER SURFACE LASER CLADDING

**Rongjuan Yang, Dongyun Ge(*), Xuan Zhao**
School of Aerospace Engineering, Tsinghua University, Beijing, 100084, China
(*)*Email:* gedy@tsinghua.edu.cn

## ABSTRACT

The similar composition to matrix magnesium alloy coating was prepared on the surface of magnesium alloy via high power laser cladding. Micro-morphology of repairing coating was characterized by scanning electron microscopy (SEM). The energy-dispersive spectrometer (EDS) and X-ray diffraction (XRD) confirmed the phase of coating. The microhardness of the magnesium alloy coatings were analyzed by microhardness tester. It was found that coatings showed good adhesion to magnesium alloy substrate. The average grain diameters of laser repaired coatings were significantly smaller than that of casting base metal, and the microstructure of laser repaired coatings consisted of the matrix α-Mg and the lamellar β-$Mg_{17}Al_{12}$ in the grain boundaries. The coating has the average micro-hardness about 180 HV, which is 2-3 times higher than that of the rare magnesium matrix.

***Keywords:*** magnesium alloys, microstructure, laser cladding, repairing.

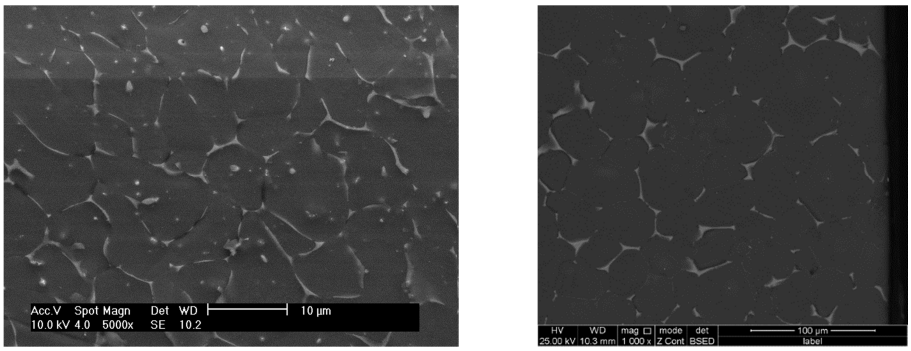
## INTRODUCTION

Due to poor surface properties, magnesium alloys are gaining interest in improving the corrosion and wear resistance. In addition, based on environmental and economic purpose of obtaining superior appearance and performance, economical repair of magnesium alloys parts also focus on academic and industrial fields. As a near-net-shape technique, laser process treatments have been investigated for the most common structural metals: steels and aluminium alloys. Little work was reported on laser cladding treatment can be used to repair magnesium parts or performance analysis after repairing. Compared with the conventional repair process, laser cladding have many advantages such as low and precise heat input, small HAZ, high processing speed and productivity and so on. Repair of the magnesium alloy parts by laser cladding is an advantageous solution in terms of performance requirement, as well as time-saving and cost-saving.

In order to avoid the high reflection rate magnesium alloy at elevated temperature, especially decreased thickness, incomplete fusion and unsatisfied performance by low power laser, high power laser with selected parameters was used in our research work. In this study, the as-received rate earth-magnesium alloy (2.76 wt% RE (Nd), 0.36 wt% Zn, 0.46 wt% Zr, and Mg in balance) was used as the substrate for laser cladding treatment with the wire which was similar composition to matrix magnesium alloy. The micro morphology of coating was characterized by scanning electron microscopy (SEM), energy-dispersive spectrometer (EDS) and X-ray diffraction (XRD). Micro-hardness was measured by means of a micro-hardness tested.

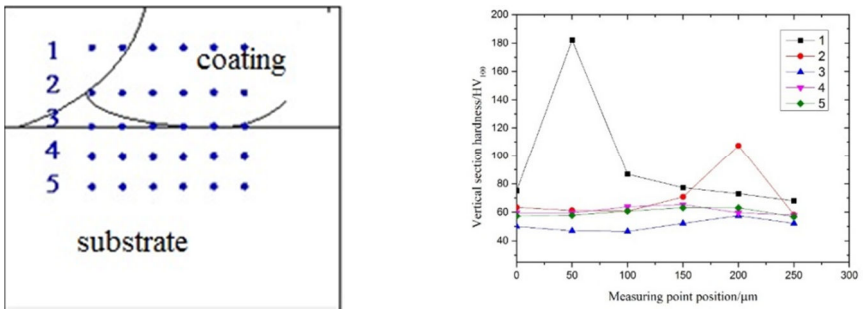
## RESULTS AND CONCLUSIONS

Figure 1 is cross-section high magnification SEM image of the coating and the substrate. It is noted that the crystalline grains are much smaller (about 2-5μm) and regular than in the substrate (about 20-50μm). The results from the micro-hardness tests are shown in Figure 2. The coating has the average micro-hardness about 180 HV, which is 2-3 times higher than that of the rare magnesium matrix.




(a) (b)

Fig. 1 - SEM images of laser cladding (a) and the substrate(b)




(a) (b)

Fig. 2 - micro-hardness test results

This study shows that it is a reliable and feasible process to repair the magnesium alloy components using laser surface cladding by wire with a similar composition to the matrix. Further tests should be performed in order to analyze other mechanical properties, such as fatigue properties.

## ACKNOWLEDGMENTS

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