Improving the Corrosion and Tribological Performance of Magnesium Alloys by Using Duplex Surface Treatments

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Introduction:

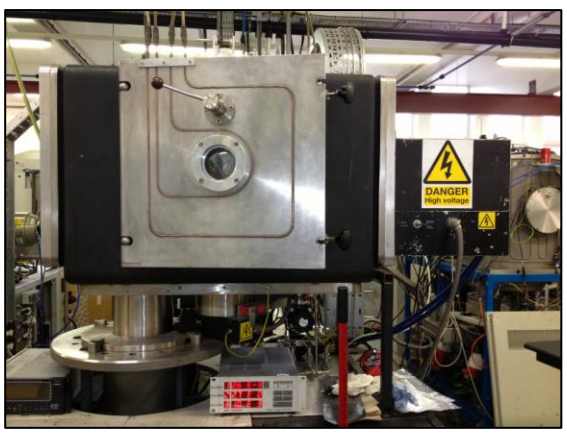
Magnesium is a promising engineering material with a high strength-to-weight ratio which enables lighter products to be achieved. Moreover, the excellent castability and weldability of magnesium alloys contribute to this material's suitability for prospective markets in the construction, automotive, aerospace and communications industries. However, several undesirable properties of magnesium alloys have prevented their widespread adoption; these include insufficient resistance to creep and poor corrosion and wear resistance. Depositing protective coatings onto magnesium alloy parts is an effective strategy to improve the corrosion and wear performance. In this work, duplex surface treatments incorporating novel PVD techniques are used to explore the wider application of magnesium alloys.

Methodology:

1. To improve the durability of low-strength Mg-alloy products in tribological applications, a relatively soft and compliant, amorphous interface layer deposited by plasma-assisted PVD to effectively accommodate substrate strain more effectively.

2. In addition, on top of the interface layer, ceramic coatings such as TiN, CrN (or plasma electrolytic oxidation post-treatments) can be deposited to increase the hardness and corrosion resistance of the surface.

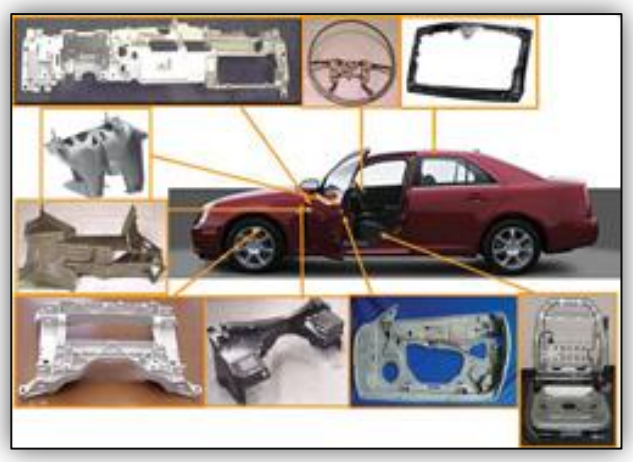
3. The treated samples are undertaken various properties tests and surface characterisation, such as reciprocating sliding wear test, impact wear test, open circuit potential measurement and surface profilometry.



Closed-field Unbalance Magnetron Sputtering System

Ball-on-plate Repetitive Impact Wear Tester

Dektak 150 Surface Profilometry Tester



Benefits:

- Improved Wear Resistance.
  Compared to hard coatings deposited directly onto Mg-alloy substrates, this design philosophy improves the matching of coating/substrate interfacial mechanical properties, such that coating toughness is enhanced by accommodation of the deformation energy without fracture.
- Improved Corrosion Resistance
  The dense coating reduces the risk of corrosion damage on the surface.

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