Preparation and characterization of MAO-Si_3N_4 composite coating on AZ31B magnesium alloy

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Micro arc oxidation process was carried out on AZ 31 B magnesium alloy using alkaline silicate based bath at a constant current density of 0.04 A/cm^2. Nano size silicon nitride (Si_3N_4) particles were added in the bath to obtain MAO- Si_3N_4 composite coatings. Plain oxide coatings were also prepared for comparison. The developed coatings were characterised for their surface morphology, composition, structure, roughness, nanohardness and wear resistance properties. Field Emission Scanning Electron Microscopy (FE-SEM) analysis of the coating exhibited the irregular porous structure with cracked morphology. Energy Dispersive Analysis of X-ray (EDX) over the surface of the composite coating showed the presence of O (42.8 wt.%), Si (13.2 wt.%), F (4.8 wt.%), Al (0.63 wt.%) and N (7.8 wt.%) with balance Mg respectively. XRD pattern obtained for composite coating revealed the characteristic peaks corresponding to Mg, MgO and Mg_2SiO_4. Apart from these peaks the presence of a low intensity peak corresponding to Si_3N_4 was also observed. Composite coating exhibited about 56% increase in nanohardness value (387 HV) compared to plain oxide coating (167 HV). Dry reciprocating wear test experiment was carried out for composite, plain oxide and substrate materials against alumina ball. Wear loss obtained for the composite is 3 times less (10 µms) compared to plain oxide coating which indicated improved wear resistance of the MAO-Si_3N_4 composite.

Key words: Micro arc oxidation; Si3N4; nano hardness; FESEM

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