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Enhancement of tribological properties of aluminum with duplex treatment of oxidation and DLC film fabricated by macroarc oxidation and cage-like hollow cathode dischargeQinwen Tian¹, Mingzhong Wu², Muqin Li²¹Shool of MSE, Jiamusi University, Jiamusi, China ²School of Materials Science & Engineering, Jiamusi University, Jiamusi, China

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Aluminum alloys have been widely utilized in many industries. However lower surface hardness and poor tribological properties limit its application to some extent. Diamond-like carbon (DLC) film is thought to be an effective layer with excellent surface properties, such as high hardness, high elasticity, low wear and low friction. However the lower hardness of aluminum alloy makes it unsuitable for direct deposition of DLC films. The hard layer given by DLC films leads to the "eggshell" effect. Thus duplex coatings or duplex treatment is expected to suppress it and get the synergistic effect. Aluminum may be oxidized by microarc oxidation (MAO) processes to achieve thick support layer for top DLC films. In this presentation the duplex processes combining the MAO and PECVD are employed to fabricate hybrid coatings. The oxidized layers with different thickness (10um, 15um, 20um, 25um) are fabricated in electrolyte mainly containing sodium silicate. Some oxidized samples are polished. All these samples are put into vacuum chamber for DLC deposition using cage-like hollow cathode discharge. The discharge is sustained using high-current pulse with voltage ranging from 1000V to 4000V. The effect of pre-oxidation step and polishing step on microstructure and surface properties of DLC films is investigated. The preliminary experimental results have demonstrated that the pre-oxidation using MAO effectively increases the adhesion between the DLC films and substrate and polished pre-oxidized samples possess better mechanical properties than unpolished ones. The DLC films are deposited with a higher rate (~4um/h) due to higher plasma density produced by high-current pulse. The surface hardness is about 10-15GPa, similar to that of typical Me-DLC. The surface morphology, interface between the DLC film and oxidized layer, tribological properties will be reported in details.

Keywords

aluminum alloy
diamond like carbon
micro arc oxidation
cage-like hollow cathode discharge
duplex treatment