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Microstructure, mechanical and tribological characterization of CrN/DLC/Cr-DLC multilayer coating with improved adhesive wear resistance

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Abstract

Adhesive wear is one of the major reasons for the failure of components during various tribological application, especially for rubbing with viscous materials. This study presents CrN/DLC/Cr-DLC multilayer composite coatings prepared on a plasma enhanced chemical vapor deposition (PECVD) device with the close field unbalanced magnetron sputtering ion plating (CFUBMSIP) technique. SEM, XRD and Raman spectroscopy were used to determine the structure of multilayer coatings. It was found that the multilayer coatings are composed by the alternating CrN and DLC layers. Compared with the single CrN coatings, the friction coefficient of the CrN/DLC/Cr-DLC multilayer coating decreases about more than seven times after sliding a distance of 500 m. This helps to reduce the adhesive wear of multilayer coatings. Compared with the single CrN and DLC coating, the wear rate of the CrN/DLC/Cr-DLC multilayer coating is reduced by an order of magnitude to 7.10×10^{-17} (sliding with AISI 440C) and 2.64×10^{-17} (sliding with TC4) $\text{m}^3/(\text{Nm})$. The improved tribological performance of multilayer coatings mainly attributes to the introduction of lubricant DLC and hard support CrN layers, the enhancement of crack propagation inhibition, and the increment of elastic recovery value W_e (71.49%) by multilayer design method.

Key words: Multilayer coatings; CrN; DLC; Friction and wear; Adhesive wear.

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