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Structural, mechanical properties and corrosion performance of multilayer Ti/Ti doped-DLC films deposited on low-carbon steel

In this work, the successful preparation of the multilayer Titanium/Titanium doped diamond-like carbon (Ti/Ti-DLC) films deposited on low-carbon steel (CS) using hybrid magnetron sputtering and plasma enhanced chemical vapor deposition methods (MS-PECVD) has been reported. The chemical and structural properties of the multilayer Ti/Ti-DLC films with varied numbers of Ti/Ti-DLC layers were characterized by Raman spectroscopy, X-ray photoemission spectroscopy (XPS) and near-edge X-ray absorption fine structure spectroscopy (NEXAFS). Their mechanical properties were investigated by using nano-indentation and nano-scratch testers. The electrochemical analysis was used to evaluate the corrosion behavior of the multilayer films which were immersed in the 3.5 wt.% NaCl solution at room temperature. Raman spectroscopic analysis revealed a gradual increase of the I_D/I_G ratio with the addition of the numbers of Ti layer. The XPS and NEXAFS results show that the sp^2 content increases by increasing the numbers of Ti layer which results in the hardness reduction. The adhesive properties were improved by adding the numbers of Ti interlayer between the CS substrate and the multilayer film. Moreover, the thicker multilayer films exhibit progressive homogeneity resulting in better corrosion resistance.

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