
Influence of Ar/C₂H₂ ratio on structure and properties of Cr-DLC films deposited on stainless steels by high power pulsed magnetron sputtering

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Abstract

In this paper, Cr-DLC films were deposited on stainless steels and Si(100) substrate by hybrid high power pulsed magnetron sputtering (HPPMS) manufactured by our group. The power supply can deliver the maximum pulsed current of 2kA. Magnetron discharge is excited using chromium in the mixture atmosphere of Ar and C₂H₂ and microstructure and surface properties of the films prepared with different Ar/C₂H₂ ratio were investigated. The experimental results showed the dense and smooth Cr-DLC films with the thickness of about 2 μ m were fabricated by HPPMS. The mean surface roughness of the films decreased with C₂H₂ flow rate increasing. The Raman spectra suggested that DLC was formed. With the increase of the C₂H₂ flow, ID / IG decreased and the content of sp³ increased at the flow of C₂H₂ from 2.5sccm to 7.5sccm. Chromium carbide was formed in the films with Cr₃C₂ (215) preferred orientation. XPS demonstrated that the elements of Cr, C and O were included and Cr mainly existed in the form of Cr atoms and Cr₃C₂. The nano-hardness of the Cr-DLC films ranged from 20GPa to 26GPa. And the films exhibited excellent wear resistance with minimum friction coefficient of 0.1, good adhesion between the films and substrate with the critical load of 38N.

Keywords: HPPMS, Cr, DLC, Ar/C₂H₂ ratio, stainless steels

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