Arc plasma deposition of multilayered a-C:H/TiSiC

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To solve the problems related to high internal stress and poor adhesion of amorphous carbon films, preparation of multilayers comprising alternating layers made of carbon and a transition metal carbide could be a promising approach. In the work reported here, a comparative investigation of the main characteristics of a-C:H/TiSiC multilayers was performed. The films were prepared on Si and steel substrates by the cathodic arc technique in a CH\textsubscript{4} reactive atmosphere, using two cathodes made of C and TiSi. The multilayer structures were analyzed in terms of composition, microstructure, morphology, modulation periodicity, mechanical and tribological properties by using XPS, XRD, X-ray reflectivity, AFM, profilometry, microhardness and adhesion measurements, and tribological tests.

The characteristics of the multilayers were found to mainly depend on CH\textsubscript{4} flow rate and modulation periodicity. In comparison with a-C:H and TiSiC monolayers, the multilayered structures exhibited lower stress levels and superior adhesion to steel substrate.

The hardness of the multilayers was determined to be in the range 30 – 36 GPa. Dry tribological tests of the a-C:H/TiSiC coatings showed low friction coefficients (0.08 – 0.12) and high wear resistance (wear rate < 10^{-7} mm^3 N^{-1} m^{-1}), so that the multilayers are expected to have good performance in real tribological applications.

Keywords
multilayer films
a-C:H/TiSiC
cathodic arc