Plasma investigations and deposition of Me-DLC (Me=Al, Ti or Nb) obtained by a magnetron sputtering-RFPECVD hybrid process

I. Bouabibsa, S. Lamri, A. Alhussein, T. Minea, F. Sanchette

PII: S0257-8972(18)31010-7
DOI: doi:10.1016/j.surfcoat.2018.09.033
Reference: SCT 23806

To appear in: *Surface & Coatings Technology*

Received date: 25 July 2018
Revised date: 4 September 2018
Accepted date: 14 September 2018

Please cite this article as: I. Bouabibsa, S. Lamri, A. Alhussein, T. Minea, F. Sanchette , Plasma investigations and deposition of Me-DLC (Me=Al, Ti or Nb) obtained by a magnetron sputtering-RFPECVD hybrid process. Sct (2018), doi:10.1016/j.surfcoat.2018.09.033

Plasma investigations and deposition of Me-DLC (Me=Al, Ti or Nb) obtained by a magnetron sputtering-RFPECVD hybrid process

I. Bouabibsa[1], S. Lamri[1], A. Alhussein[1], T. Minea[2], F. Sanchette[1]

[1]ICD LASMIS, Université de Technologie de Troyes, UMR6281, CNRS, Antenne de Nogent, Pôle Technologique de Haute-Champagne, 52800 Nogent, France
[1]NICCI, LRC CEA-ICD LASMIS, UTT, Antenne de Nogent-52, Pôle Technologique de Haute-Champagne, 52800 Nogent, France
[2]LPGP, Univ. Paris-Sud/CNRS, Université Paris-Saclay, 91405 Orsay, France

Abstract

DLC based coatings are now widely used for many applications. Me-doped DLC (Me=Metal) are studied intensively in order to optimize properties such as low compressive stress, low friction coefficient and higher tribological performance. These Me-DLC coatings are often deposited by means of a PVD/PECVD hybrid process, but few studies attempt to describe the phenomena involved in these complex processes. In this work, DLC is obtained in the $Ar+H_2+C_2H_2$ mixture by RF-PECVD and the metal, which is in-situ, is added by magnetron sputtering of pure metal targets. Plasma is investigated by means of Optical Emission Spectroscopy and the main phenomena between the target and the substrate are described. The results show that atomic aluminium emission line intensity decreases continuously, moving away from the Al target whereas Ti and Nb lines are weak near electrodes and reach a maximum in the centre of the target-substrates gap. This difference is due to the low mass of Al as well as its rapid thermalisation. Addition of a metallic element (Al, Ti or Nb) in DLC seems to lead to a disorder within the carbon matrix. Carbides precipitate in Ti-DLC and Nb-DLC for high metal contents. The addition of Ti or Nb in the DLC matrix leads to open morphologies associated with high surface roughness. Like the non-doped DLC, Al-DLC coatings have a compact morphology and low surface roughness.

Keywords: DLC; metal doping; magnetron sputtering, RF PECVD; Optical Emission Spectroscopy