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Study on the properties of modified amorphous carbon thin films deposited by PECVD

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Amorphous hydrogenated carbon (a-C:H) layers are frequently deposited by plasma enhanced chemical vapor deposition (PECVD) processes. This technology is very promising because of its high control of film quality, its easy integration in current technologies, its low cost, high efficiency and reproducibility. Radio frequency PECVD techniques are accepted as the most popular laboratory method to prepare hydrogenated DLC films from a hydrocarbon precursor. Moreover, in the recent years hydrogenated carbon thin films (HDLC) have attracted increased attention due to their extraordinary physical and chemical properties that are promising for a wide range of applications. The aim of this work is to characterize and compare the properties of HDLC as well as deuterated carbon thin films (DDLC) deposited by RF-PECVD from two different precursor mixtures methane/hydrogen (CH_4/H_2) and methane/deuterium (CH_4/D_2) on single crystalline silicon, glass and polycarbonate substrates. Mechanical tests were performed mainly using depth sensing indentation method. We focused our attention on the following coating properties: hardness, elastic modulus, fracture toughness, film-substrate adhesion. Moreover, we studied the effect of the internal stress on the indentation response of the film-substrate systems. The characterization of the thin films surface was done by contact angle measurements and surface energy calculation. The layer composition was investigated by Rutherford backscattering spectrometry (RBS) in combination with elastic recoil detection analysis (ERDA). The results will be completed by atomic force microscopy (AFM), scanning electron microscopy (SEM) and optical studies (ellipsometry and spectrophotometry measurements) on the given samples. Raman spectroscopy is conveniently employed to study the phenomena in these materials at the sub-microscale levels. Advanced plasma diagnostics were performed by means of optical emission spectroscopy (OES).

Keywords
RF-PECVD, amorphous carbon, protective coatings