PO1067

Optical versus microscopic properties of ECR and RF-bias generated amorphous hydrogenated carbon layers

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Carbon-based layers have been investigated as protective coatings for mechanical applications for several decades. Recently, hydrogen-containing amorphous carbon (a-C:H) layers deposited in CVD processes have been studied intensively. In this paper, the analysis of a-C:H layers deposited in a PA-CVD process from gaseous precursors with different plasma sources (ECR and RF bias) is presented. The different sources generate a collisional and non-collisional plasma-chemical environment, respectively. The resulting layers are different in their mechanical properties, but also in their microstructure. Careful analysis with several spectroscopic methods (Raman, XPS) reveals an aliphatic matrix with different contents of olefinic and aromatic clusters. First evidence of the presence of sp-hybridised carbon atoms is also found in these samples.

By analysing the optical properties in the visible and infrared, a connection can be established between the optical behaviour of thin carbon layers and their atomic structure. Further, the layers can be tailored to a special optical behaviour, e. g. making them transparent to serve as dielectrics within a certain spectral range. Spectroscopic ellipsometry is a key technique to directly gain this kind of information. Ellispometric measurements have been performed on amorphous carbon layers in the visible-NIR as well as the MIR spectral range.

By characterising carbon layers in this way, a new class of materials with desirable optical as well as mechanical properties becomes feasible.

Keywords
carbon layers
PA-CVD
optical properties
thin layer spectroscopy
ellipsometry