Titano koncentracijos įtaka deimanto tipo anglies dangų struktūrai ir savybėms

Influence of the titanium concentration on the structure and properties of diamond-like carbon films

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Newly, various metals such as (Ti, Cr, Zr, Ni, Au, Ag) as well the non-metals elements (Si, O, N, F) were excessively used as doped materials in the diamond-like carbon (DLC) films. Each dopant has its role in modifying the film structure and as consequence enhancing a desirable property for different DLC film types and in several application domains [1-3]. The doping process of DLC films with titanium has repetitively demonstrated its enhancing role of the tribological and mechanical characteristics, like reducing the compressive stress, friction coefficient and enhancing the corrosion and wear resistance as well improving the hardness [1,4].

Titanium doped amorphous DLC films were deposited on Si (100) substrates by magnetron sputtering at fixed target-substrate distance (3 cm). The graphite and Ti targets were used. The Ti cathode current was changed from 0.25 A to 1.00 A and the deposition duration was 600 s. The surface morphology, adhesion and friction forces, elemental composition, optical transmittance and structure of the sputtered Ti-doped DLC films were investigated by atomic force microscopy (AFM), energy dispersive X-ray spectroscopy, UV–VIS–NIR spectrophotometer and Raman spectroscopy. Using both a sharp and ball on the tip cantilevers, the AFM images provides the lateral deflection signals then after the calibration of these data, the fiction coefficient were determined.

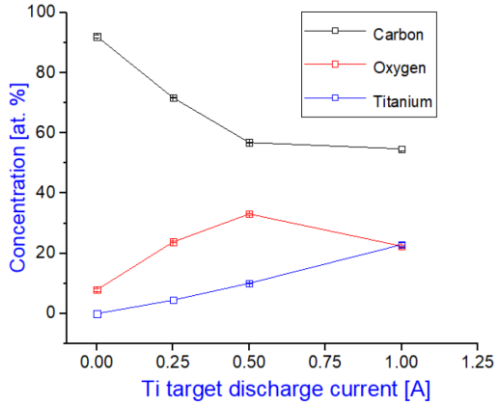

Figure 1:The elemental concentration of films versus the Ti discharge current.

It was obtained that the Ti concentration was increased with the increasing of the Ti cathode current, meanwhile the Raman data indicated that the sp^2 carbon sites fraction increased, and the graphitization was induced. The surface roughness slightly increased from ~0.9 nm to 1.7 nm with the increase of Ti content from 4.5 at. % to 22.9 at. %. The results indicated that the surfaces of the doped DLC films have a self-affine shape. The adhesion force between the polymer ball on the top of the cantilever and the thin film decreased from ~14 nN to ~6 nN and the transmittance values were sharply reduced at 22.9 at. % of Ti from ~0.1 % to ~8.5% in the range of 365 nm to 890 nm wavelength. The friction coefficient with the sharp cantilever was the lowest (~0.175), when Ti content in DLC was ~4.5 at. %. While the lowest lateral deflection signal was recorded for the doped DLC film with the highest Ti concentration.

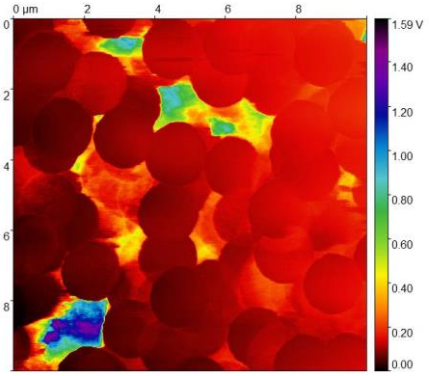

Figure 2: The lateral force images using AFM of the film.

Keywords: diamond-like carbon films, titanium, atomic force microscopy, surface morphology, friction force.

Literature

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