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Characteristics of TiC/a-C nanocomposite films prepared by closed-field unbalanced magnetron sputtering for bio-medical application

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Hydrogenated amorphous carbon films (a-C:H or DLC) have several excellent properties, such as high hardness, high wear resistance and low friction coefficients. These films are therefore widely used as protective coatings. We investigated the change in the tribological properties of amorphous carbon films fabricated by closed-field unbalanced magnetron sputtering method with TiC thin films as the adhesive layer. Ti-containing nano-composite carbon thin films were prepared using the closed-field unbalanced magnetron sputtering method using graphite and titanium as targets. We tried various structures for the interlayer under hydrogenated amorphous carbon (a-C:H) film, to improve the tribological properties and observed characteristic changes in the nano-composite structure. In the results, we found that nano-composite film structure improved tribological properties, such as high hardness, low friction coefficient, low surface roughness and good adhesion of a-C:H thin films. And also, it was found that coatings with added negative DC bias voltage could provide better improvement of adhesion strength, hardness, surface roughness and friction coefficient of films simultaneously, while exhibiting the Ti doping effect. With Ti-doped a-C:H in laminated structure, the tribological properties were observed to be improved to high hardness value over 29 GPa, high elastic modulus over 235 GPa, and a smooth surface below 0.8 nm.