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The role of applied bias on the properties of HiPIMS deposited nc-TiC/a-C:H coatings

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Nanocomposite coatings consisting of nanocrystallites embedded in an amorphous matrix such as nc-TiC/a-C:H can be tailored to exhibit an unusual combination of properties like high hardness and elastic modulus combined with low friction and wear. These coatings are usually deposited utilising direct current magnetron sputtering (DCMS) leading to low ionisation of the sputtered titanium and to lower Ar⁺ ion bombardment impinging the growing coating. The ion bombardment of the substrates is routinely enhanced via increasing the energy of the bombarding ions due to the application of a negative bias onto the samples. The use of high power impulse magnetron sputtering (HiPIMS) usually leads to much higher ionisation of the sputtered titanium which can alter the deposition process and to more severe ion bombardment of the growing coating changing the properties of the deposited coatings. This contribution investigates the effect of the applied bias on the properties of nc-TiC/a-C:H coatings prepared by HiPIMS as the standard practice of “applying a bias for enhancement of coating properties” used for DCMS prepared coatings may not be easily applicable in HiPIMS. It will be shown that a simple “copy-paste” principle of methods useful for working with Ar⁺ ion dominated DCMS plasmas may not necessarily lead to better coatings when metal dominated plasmas such as in HiPIMS are used. It will be shown that ion bombardment by heavy high energy film forming titanium ions may lead to microstructure changes leading to “weakening” of the coating structure that is highly detrimental for mechanical properties of the deposited coatings. Different bias levels will be discussed and levels of bias favourable for deposition of super-hard nc-TiC/a-C:H coatings using HiPIMS will be shown.

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Keywords

nanocomposites

HiPIMS

magnetron sputtering