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Optical emission spectroscopy of TiN/a-C composite film deposition by magnetron sputtering in magnetized sheet plasma source

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TiN/a-C composite films were deposited on Ti/TiN coated stainless steel substrates by magnetron sputtering of the Ti target with Ar/N₂/C₂H₂ working gases using a magnetized sheet plasma source. Optical emission spectroscopy (OES) was employed during the carbonitriding process, and for varying C₂H₂ ratio and discharge current, to identify the species present in the plasma. It was found that measurement of the emission spectra allowed prediction and optimization of the plasma deposition. Spectral lines of Ar (II), Ti (I), C (II), N₂⁺, and CN species were found at 423.5 nm, 362.5nm, 391.4 nm, 426.5 nm and 388.3 nm, respectively. The populations of the different species were correlated with the hardness of the film as measured using Vickers hardness test. The highest hardness results for varying deposition parameters are 24.83 GPa and 27.18 GPa, for 25% acetylene ratio and 2A discharge current, respectively, which are attributed to the large population of C (II) species. Langmuir probe measurements were also evaluated to support the OES results.

Keywords

Optical emission spectroscopy

Magnetron sputtering

Carbonitridation

TiN

TiN/a-C