Automatic and robust deposition process control to grow hard nc-TiC/a-C:H coatings using industrial magnetron sputtering devices

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nc-TiC/a-C:H coatings consist of TiC crystallites embedded in an amorphous hydrogenated carbon matrix. Depending mainly on the chemical composition (ratio of Ti/C), the properties of these coatings can be tailored from hard coatings to tribological coatings, with low coefficients of friction and wear. However none of the major industrial coating centers offer this coating in their portfolio, probably because of the lack of the reliable deposition technology. In our research, we employed industrial PVD device of Platit equipped with a central titanium rotating cylindrical cathode. Titanium was sputtered in a mixture of argon and acetylene. When the acetylene supply was gradually increased, deposition process characteristics such as the cathode voltage and the total pressure in the deposition chamber underwent a sudden change. At critical acetylene supply, a sudden drop in the cathode voltage was observed, while before and after the drop, the cathode voltage evolved slowly. This sudden change in the plasma parameters was mirrored in chemical composition and mechanical properties of the deposited coatings. Close to critical acetylene supply, the highest coating hardness of 35 GPa was obtained. The critical acetylene supply shifts as the target gets eroded. In our work, we suggest the fully automatic, robust and reliable procedure to deposit hard nc-TiC/a-C:H coatings using the occurrence of the sudden plasma parameters change at critical acetylene supply to set the optimal deposition conditions. The procedure automatically controls the acetylene supply as a function of the cathode voltage and the pressure evolution. The process control was tested for different states of the target erosion and different chamber configurations. This research has been supported by the Z.1.05/2.1.00/03.0086 and GACR P205/12/0407 projects.

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TiC