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Synthesis and Characterization of Ta/TaN Coatings with CFUBMS-HiPIMS Technology

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Abstract

The aim of this work is to study the mechanical and tribological behavior of Ta/TaN coated 52,100 tool steel. Ta/TaN thin film have been deposited by CFUBMS-HiPIMS method. In the early 2000s, it started to show itself in R&D studies with the technological developments in electronic power designs for HiPIMS technology. Today, HiPIMS has been integrated and successfully used as a hybrid in magnetic field sputtering systems for R&D purposes and industrial scale. HiPIMS technology provides a stable and uniform discharge plasma formation with high current density, ensuring that the growth of the high-density coating and the adhesion bond at the interface is strong. The development of graded Ta/TaN coating structures to optimize adhesion and wear behavior are crucial in high adhesion and lower wear levels when depositing very hard brittle coatings. Ta/TaN films have excellent friction and wear properties. For this reason, it is predicted that it will be effective in increasing efficiency and performance for many industrial applications, especially in biodiesel injectors. Studies on the mechanical and tribological characteristics of the TaN system in comparison to other transition metals, however, are few since it has a hard protective layer. This work looked into the mechanical and tribological characteristics of thin Ta/TaN thin films. The maximum hardness (28.069 GPa) was obtained for the film deposited at 9 sccm N₂ amount. The highest critical load value is achieved as 45 N. The lowest coefficient of friction value (0.419) obtained was found in the R1 film, where the lowest deposition pressure (0.27) was applied. © 2023, The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd.

Author Keywords

Adhesion; Ta/TaN; Tribological properties

Index Keywords

Friction, Hard coatings, Tantalum compounds, Thin films, Tool steel, Transition metals, Tribology, Wear of materials; Mechanical behavior, Mechanical characteristics, Power design, Synthesis and characterizations, Ta/TaN, Technological development, Thin-films, Tribological behaviour, Tribological characteristics, Tribological properties; Adhesion

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