INTELLIGENT LUBRICATING COATINGS BASED ON THE OBLIQUE ANGLE DEPOSITION TECHNOLOGY

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ABSTRACT

This research introduces an innovative approach to construct intelligent lubricating coatings by filling lubricants into the oblique angle deposited hard porous film. Oblique angle deposition as an attractive technique in physical vapor deposition is utilized to synthesize nanostructured thin films with controlled modification of morphology, such as porosity and column inclination. Under the influence of the shadowing effect, the oblique angle deposited TiN-based films often display porous morphology. Thus, the process begins with the oblique angle deposited porous TiN-based films. The hard porous films cannot only conduct as a load-bearing layer to improve the wear resistance, but also serves as storage space for the lubricant. In this research, carbon filled porous TiN coatings have been constructed, which exhibits lower friction than TiN film while yet having similar mechanical properties to the latter. Furthermore, humidity-adaptive "chameleon" coating was designed by filling the MoS_2 on oblique angle deposited porous TiCN film. Under low humidity condition, the filled MoS_2 lubricant release to the contact surface to form a low friction tribofilm [1]. While, this MoS_2-based tribofilm would fail and be removed by the friction force under high humidity condition, but the carbon phase in TiCN films would immediately release to contact surface to form a new low friction tribofilm [2]. Therefore, the constructed MoS_2 filled TiCN coatings can respond to changing humidity conditions by self-adjustment of contacted surface properties to maintain good tribological performance in fluctuating humidity conditions. In conclusion, the research indicates that oblique angel deposition of hard porous film to store the lubricants offers a novel strategy to designed the intelligent lubricating coatings. By reasonable design of the structure and composition of porous film and filled lubricants, various intelligent coatings are expected to be constructed, marking a significant advance on the field of surface engineering, especially for the applications under fluctuating environmental conditions.

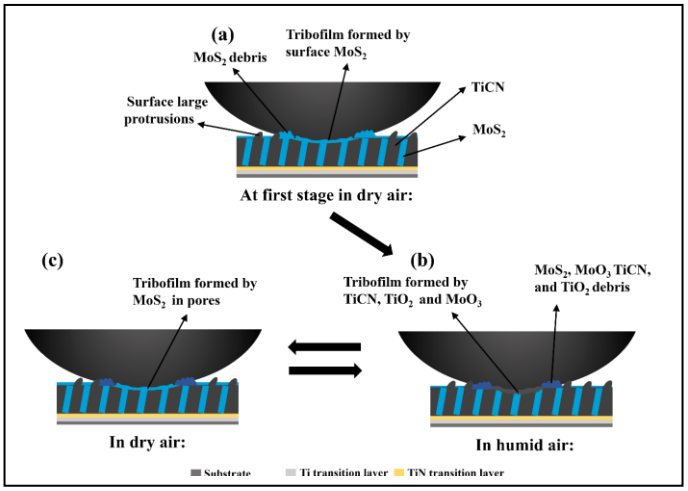

Fig.1 Schematic diagram of the mechanism of self-adaption lubrication of Ti60CN-OAD-MoS2 composite coating to the fluctuant humid conditions: (a) the first sliding stage in dry air, and (b) the second stage in humid air and (c) in the following dry air condition.

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