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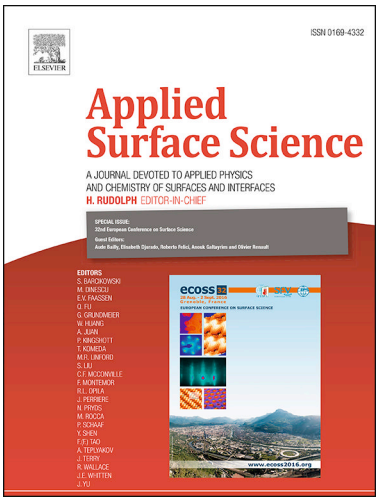

Full Length Article

The roles of Ag layers in regulating strengthening-toughening behavior and tribochemistry of the Ag/TaC nano-multilayer films

Ping Ren, Kan Zhang, Mao Wen, Suxuan Du, Jianhong Chen, Weitao Zheng

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The roles of Ag layers in regulating strengthening-toughening behavior and tribochemistry of the Ag/TaC nano-multilayer films

Ping Ren, Kan Zhang, Mao Wen*, Suxuan Du, Jianhong Chen, Weitao Zheng*

State Key Laboratory of Superhard Materials, Department of Materials Science, and Key Laboratory of Automobile Materials, MOE, Jilin University, Changchun 130012, People's Republic of China.

Abstract

Though the high hardness nature of transition-metal carbides or nitrides TMC(N) has been extensively exploited in protective films for various tools and wear-resistant films for the machine parts, improving toughness and reducing friction continue to be immensely challenging. Herein, we prepared the Ag/TaC nano-multilayers with various Ag thickness (l_{Ag}) ranging from 2 nm to 14 nm by magnetron sputtering, successfully achieving enhanced hardness, toughness and wear-resistance ability, together with reduced friction at l_{Ag} = 2 nm. In addition, l_{Ag}-dominated growth, strengthening-toughening behavior, and tribochemistry of the Ag/TaC nano-multilayers were investigated. These studies revealed that as very thin Ag layers (= 2 nm) are alternatively inserted into TaC layers, discontinuous Ag/TaC nano-multilayer structure constructs in term of poor wetting induced the growth of discontinuous Ag layers, remarkably enhancing the hardness to ~42 GPa associated with the Orowan mechanism and improving toughness and wear-resistance ability. Together with all these remarkable properties, the coefficient of friction (CoF) rapidly drops to ~0.227, because of the formation of lubricious Ag nanoclusters and $AgTaO_3$ phase on the contact surface during sliding. However, at thicker l_{Ag}, continuous soft