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Phase evolution and triblogical properties of molybdenum- and tungsten carbide coatings

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Carbides have been in the focus of materials scientists for decades, due to their interesting mechanical properties and high temperature behaviour. Recently, they have also been investigated as reactive surfaces for tribological contacts to sustain tribo-chemical reactions to achieve self-lubrication. This lubricating effect in combination with excellent mechanical properties identifies tungsten carbide and molybdenum carbide as potential candidates for protective coatings with enhanced wear performance.

The wear protection and tribological capabilities of those coating materials, do not solely rely on the in-situ formation of solid lubricants such as MoS_2 and WS_2 but also require excellent mechanical properties. While hexagonal δ-WC benefits from high hardness and hence good abrasive wear protection, its thin films are very brittle and suffer from differences in thermal expansion coefficient compared to substrate materials, as well as carbon loss during the sputtering process. As a result non-reactively sputtered coatings have a tendency to form a sub stoichiometric cubic WC_{1-x} phase with inferior properties. In comparison, molybdenum carbide coatings don’t demonstrate this tendency to sub stoichiometric structures and offer an easy access to tribo-reactive phases obtaining easy-sliding shear planes.

This work focuses on the phase evolution of non-reactively sputtered Mo and W based carbide coatings in relation to the carbon content and the influence of structural defects, such as carbon vacancies. The phase evolution was correlated to the obtained wear performance using x-ray diffraction, transmission electron microscopy and ball on disk tribotests.

Keywords
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