Comparison of wear resistance and biological properties of $Ag/W_{1-x}Ti_xB_{2.5}$ nanocomposite and pure silver coating

[1]Katarzyna Zielińska, [1]Tomasz Mościcki
[1]Institute of Fundamental Technological Research, Polish Academy of Sciences, Pawinskiego 5B, 02-106 Warsaw, Poland

Published: 16 May 2025 by **MDPI** in **4th Coatings and Interfaces Online Conference session Coatings and Thin Film Deposition**

ABSTRACT

Transition-metal borides have exceptional mechanical properties, such as high hardness and fracture toughness. They also have high thermal and chemical stability. Silver, on the other hand, is an attractive material for antibacterial applications due to its biological properties. Combining these materials can make it possible to produce super-hard coatings with antibacterial properties that are also wear-resistant, even under extreme temperature conditions.

In this work, $Ag/W_{0.84}Ti_{0.16}B_{2.5}$ nanocomposite layers were deposited, comparing their properties with a film made of pure silver. The silver film was produced by pulsed laser deposition (PLD), while the titanium-doped tungsten boride layer was synthesized by high-power pulsed magnetron sputtering (HiPIMS). The structure and chemical composition of the films were characterized by scanning electron microscopy (SEM) and X-ray energy spectroscopy (EDS). The silver particles were uniformly covered with a coating of borides. The surface roughness of the composite was about 100 nm (Ra) and was much higher than the roughness of the layer consisting only of metal borides.

Mechanical properties such as hardness were tested using The Micro Combi Tester MCT3, while wear resistance was verified by abrasion under a reciprocating motion. The silver layer can favourably affect mechanical properties by improving the material's ductility and tribological properties, at the expense of lowering hardness. Biological tests were carried out in a liquid suspension of Staphylococcus Aureus bacteria (a Gram-positive bacterium). Incubation was carried out for 20 hours in a greenhouse at 37°C. Unfortunately, from the studies so far, the composite has not been found to show antibacterial properties in the classic suspension test.

Keywords: HiPIMS magnetron sputtering; pulsed laser deposition; nanocomposite; transition metal borides; silver