Nanocomposites based on transition metal borides and silver in view of mechanical and antibacterial properties

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Transition metal borides are becoming increasingly popular due to their unique properties. They are outstanding not only for their very high hardness and fracture resistance, but also for their considerable chemical and thermal stability. Silver, on the other hand, is valued as an antibacterial material due to its unique biological properties. The combination of these two materials may enable the development of an innovative super-hard composite with antibacterial properties.

In this study, it was decided to create Ag/WB2.5, Ag/W0.84Ti0.16B2.5 nanocomposites and compare their properties to the individual composite components. The silver coating was produced by pulsed laser deposition (PLD), while the WB2.5 and W0.84Ti0.16B2.5 coatings were produced by high-power pulsed magnetron sputtering (HiPIMS). Subsequently were carried out a series of necessary tests for the realisation of the work's topic. The microstructure and surface morphology were characterised using a scanning electron microscope (SEM) with chemical composition analysis (EDS) and an optical profilometer. The observations revealed that the silver particles are uniformly covered by a coating of tungsten borides. This contributed to a reduction in the roughness of the composite compared to a layer composed of pure silver (Ra of about 100 nm).

In order to determine the mechanical properties, hardness tests, adhesion of the coatings by scratch-test and wear resistance by abrasion in reciprocating motion were tested. As a result of the presence of the silver film, the wear resistance increased compared to the coating composed of W0.84Ti0.16B2.5.
The biological properties of the materials were assessed by a test in a liquid suspension of Staphylococcus Aureus bacteria (Gram-positive bacterium). The samples were incubated in a greenhouse at 37°C for a specified time and then analysed for changes in the number of bacterial colonies.

References:
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