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MAGNETRON SPUTTERING AND LEHCEB SYNTHESIS OF TI-NB, TI-W AND TI-TA SURFACE ALLOYS FOR THE ENHANCEMENT OF MECHANICAL PROPERTIES AND WEAR RESISTANCE

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Titanium and its alloys are characterized by excellent mechanical and corrosion resistance properties that make them interesting for various applications such as in automotive and aerospace fields, and biomedical implants. [1] However, titanium is characterized by poor wear resistance restricting its application. There is the possibility to enhance such property by forming surface alloys of titanium with other metals.

By combining magnetron sputtering deposition and Low Energy High Current Electron Beam (LEHCEB) it is possible to produce surface alloys with improved properties, by keeping the bulk properties unaltered. In this way the outermost micrometric layer can be characterized by higher microhardness, lower elastic modulus and lower friction coefficient. [2, 3]

In the present work chemical etched and LEHCEB pretreated (20 kV and 5 pulses) c.p. Ti substrates were prepared, then thin films of Nb (100 nm), W (350 and 700 nm) or Ta (700 nm) were deposited by DC magnetron sputtering onto substrates. Finally, surface alloying was carried out by LEHCEB, by varying the acceleration voltage (25 and 30 kV) and the number of pulses (from 10 to 80), depending on the thermophysical properties of thin films metals.

The surface alloys were characterized in terms of chemical and phase composition. Mechanical properties (Vickers microhardness and elastic modulus) were investigated as well friction coefficient through wear resistance tests, both on treated and untreated samples.

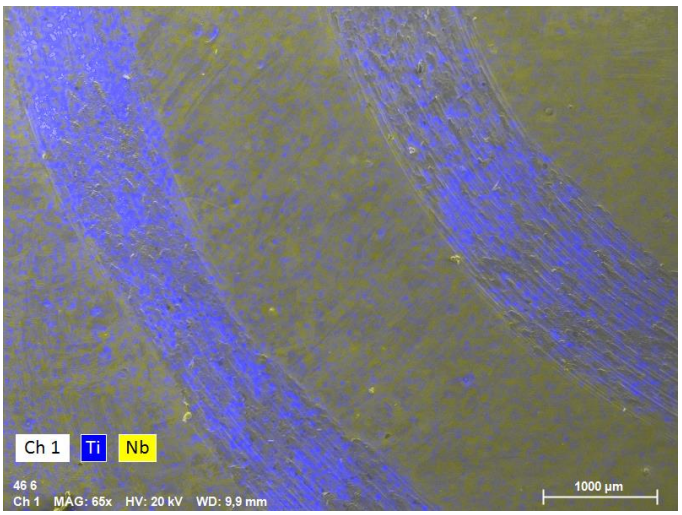

Fig.1. Surface EDS map of the Al_2O_3 ball trace left on Ti-Nb wear tests on sample synthetized with 100 nm of deposited Nb and LEHCEB alloyed at 25 kV with 10 pulses.

REFERENCES

[1] R. P. Kolli and A. Devaraj, "A review of metastable beta titanium alloys" Metals (Basel), vol. 8, no. 7, pp. 1–41, 2018

[2] J. X. Zou, K. M. Zhang, S. Z. Hao, C. Dong, and T. Grosdidier, "Mechanisms of hardening, wear and corrosion improvement of 316 L stainless steel by low energy high current pulsed electron beam surface treatment," Thin Solid Films, vol. 519, no. 4, pp. 1404–1415, 2010.

[3] F. Morini, M. Bestetti, S. Franz, A. Vicenzo, A. Markov, E. Yakovlev, "Synthesis and Characterization of Ti–Nb Alloy Films Obtained by Magnetron Sputtering and Low-Energy High-Current Electron Beam Treatment", Materials, vol. 14, 2021.