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Synthesis and characterization of titanium boride coatings fabricated by selective electron-beam surface alloying

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In this study, Ti-B coatings were fabricated by a selective electron-beam surface alloying technology. On a pure titanium substrate, a boron film with a thickness of about 1 μm was deposited by an electron-beam physical vapor deposition technique. During the deposition procedure, the accelerating voltage was 50 kV, the electron beam current was 18 mA, the beam diameter was 10 mm, and the deposition time was 90 seconds. The obtained specimens were then subjected to a selective electron-beam surface alloying technique. During the alloying procedure, the accelerating voltage was 55 kV, the electron beam current was 25 mA, the diameter of the electron beam was 0.5 mm, the scanning frequency was 1000 Hz, and the speed of the specimen motion was varied from 5 to 50 mm/s.

The specimens were characterized in terms of their phase and chemical composition, microstructure, and microhardness. The phase composition was studied by X-ray diffraction (XRD) using Cu Kα (1.54 Å) characteristic X-ray radiation. The experiments were carried out in symmetrical Bragg-Brentano mode. The microstructure was investigated by scanning electron microscopy (SEM), where back-scattered electrons were used. The chemical composition was studied by energy-dispersive X-ray spectroscopy (EDX). The EDX detector system integrates P/B ZAF quantitative corrections (Z being the atomic number correction factor; A – X-ray absorption correction factor; F – fluorescence correction factor). Investigations of the microhardness were carried out on an EMCO Test DuraScan 20 G5 device using a load of 25 g, time 10 s, and gradient of 10 g/s.

The microhardness of the fabricated samples is discussed concerning the applied technological conditions of the selective electron-beam surface alloying procedure, corresponding phase and chemical composition, and microstructure.

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