Surface modification of the Ti-6Al-4V alloy with boriding treatment

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Abstract. Surface modification through boriding and aluminizing is a key method for improving the mechanical properties of titanium alloys; however, the mechanisms that control layer formation are not fully understood. A study was conducted to investigate the microstructural evolution and diffusion dynamics of borided and aluminized layers on titanium alloy. Boriding and aluminizing treatments were performed at different temperatures and holding times, and the resulting samples were analyzed using scanning electron microscopy (SEM), X-ray diffraction (XRD), and electron probe microanalysis (EPMA). The borided layer was found to consist of an outer TiB2 layer and underlying TiB whiskers, while the aluminized layer consisted of an Al3Ti compound layer and an aluminum diffusion layer. Layer thicknesses were measured, and growth kinetics were modeled using the diffusion equation. The diffusion activation energies were determined to be 170.58 kJ/mol for [B] atoms in the borided layer and 213.55 kJ/mol for [Al] atoms in the aluminized layer. Based on experimental observations, the growth processes of both layers were analyzed and discussed.

Keywords: Titanium, boriding, characterization, aluminizing.