Structural characteristics and outward–inward growth behavior of tantalum oxide coatings on tantalum by micro-arc oxidation

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Abstract

The coatings composed of $CaTa_2O_6$, Ta_2O_5 and TaO were formed on pure tantalum by micro-arc oxidation in electrolytic solutions of calcium acetate and β-glycerophosphate disodium using a pulse power supply. The morphologies, phase components, bond strengths and growth behavior of the coatings with increasing the micro-arc oxidation (MAO) time were investigated. The obtained results demonstrate that the coatings are porous without apparent interface to tantalum substrates and can tightly bond to the substrates. The growth of the coatings micro-arc oxidized (MAOed) at 350 and 450 V with MAO time exhibits similar outward–inward growth characteristics, which contains three stages. At earlier stage of MAO (e.g., from 0 to 1 min), there is a dramatic increase in the total thickness and the total growth rate of the MAO coatings, and outward-growth dominates the growth behavior of the coatings. From 1 to 5 min, the total thickness of the coatings increases gently and the total growth rate declines sharply; at this stage, the outward growth gradually slows down, and the inward growth maintains persistent enhancement. At later stage of MAO (e.g., from 5 to 15 min at 350 V and 5 to 20 min at 450 V), the inward growth plays a predominant role in the growth of the coatings.

Keywords: inward and outward growth, tantalum oxide coating, micro-arc oxidation

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