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Changes induced by the process parameters in the oxide layers grown by PEO onto Al and Mg alloys

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Plasma electrolytic oxidation (PEO) also known as micro-arc oxidation has gained a growing interest over the last years since this plasma assisted electrochemical treatment allows dense, thick and hard oxide layers to be grown onto light metallic (alloy) surfaces (Al, Mg, V, Ti, etc.). The ceramic layers thus obtained exhibit excellent wear-protection and corrosion-resistance properties.
The PEO process consists in applying a potential difference between the work piece to be treated and a counter electrode which are both immersed in an alkaline electrolyte. An increase in the applied voltage results in the dielectric layer breakdown, allowing thus the oxidation process to continue.
Despite the considerable interest in this process, especially in the processing of aluminium and magnesium alloys, there is no clear understanding of the underlying discharge mechanisms that make possible the metal oxidation up to 100's µm through the ceramic layer. Moreover, no clear relationship has been established between the process parameters and the resulting layer characteristics.
In the present work we study the influence of some process parameters on both the discharge behaviour and the characteristics of the resulting oxide layers in terms of thickness and roughness. A particular attention is paid on the electrode gap which is shown to modify the micro-discharge characteristics, thus resulting in modifications of the growth rate and the surface roughness. To our knowledge, such influence of the electrode distance on the characteristics of the grown oxide layer has never been reported before.
Meanwhile, for different current shapes and electrode gaps, accurate determination of the lifetime and the precise localisation of the micro-discharges is performed using fast video imaging (≥10000 fps) thus allowing us to get new insight into the possible mechanisms that sustain the oxidation process.

Keywords
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