

Recent advances in electrolytic plasma technologies for surface engineering of light alloys

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*Plasma Electrolytic
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Abstract Current trends towards sustainable, resource- and energy efficient manufacturing bring surface engineering on lightweight substrates at the forefront of research interest. Plasma Electrolytic Oxidation (PEO) attracts significant attention as an advanced technology platform for development of high-performance protective and functional coatings on Al, Mg and Ti alloys. PEO affords uniform treatments of irregular surfaces that are inaccessible by conventional line-of-sight coating technologies thus offering a greater design freedom for lightweight structural components, functional devices and consumer products. Numerous process variables influencing coating characteristics provide significant challenges for development and optimisation of advanced PEO processes. To overcome these challenges we propose intelligent approaches that rely upon embedded quasi-autonomous digital control loops featuring appropriate diagnostic tools and digital twins. Recent progress in the development and application of experimental methods for active diagnostics of PEO processes provides important insights into fundamental mechanisms underlying electrochemical behaviour of materials under transient conditions of high voltage pulse and pulse-reverse polarisation. The talk will discuss practical significance and implications of these findings for process energy efficiency and real-time control over coating characteristics and properties illustrated by examples of our approaches to coating development for specific application requirements.