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Plasma current analysis using discrete wavelet transform during plasma electrolytic oxidation on aluminum

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Abstract

Orthogonal Discrete wavelet transform (ODWT) was employed to analyze plasma currents at different time stages of potentiostatic plasma electrolytic oxidation (PEO) on commercially pure aluminum. The results of wavelet transform were presented in the form of energy distribution (ED) and standard deviation of partial signal (SDPS) plots. The variations of PEO coating morphology with processing time were also studied by scanning electron microscope (SEM). The comparison of the ED plots at different processing time stages indicated that the current transient shapes remained unchanged during the whole PEO process. Similarly, a detailed comparison of the SDPS plots indicated that the intensity and lifetime of plasma discharges increased and their frequentness decreased with processing time. The SEM micrographs of the surface and cross section of the coating supported the findings of wavelet transform in case of both pore size and population. It was also shown that the lifetime of B-type plasma discharges which were responsible for the dielectric breakdown phenomena and coating thickness enhancement, increased from ~ 80 μs to ~ 160 μs with time. In addition, increasing the intensity and lifetime of B-type plasma discharges led to regeneration of the interfacial voids and discontinuities, particularly in the last stages of the process.

Keywords: Plasma electrolytic oxidation; Orthogonal Discrete wavelet transform; Dielectric breakdown; Plasma discharge